BULLETIN

(*formerly* JOURNAL)

OF THE

AMERICAN GEOGRAPHICAL SOCIETY

OF

NEW YORK

MDCCCCIII

VOL. XXXV

NEW YORK
PUBLISHED BY THE SOCIETY

CONTENTS.

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BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXV **1903.** **No. 1**

THE SYRIANS OF PERSIA AND EASTERN TURKEY.

BY

WILLIAM A. SHEDD.

It is the purpose of this paper to describe as briefly and accurately as possible the origin, the condition, and the numbers of the so-called Syrian Christians living in the vilayets of Van and Mosul, in Turkey, and in the regions adjoining Lake Urumia, in Persia. It is difficult to get an altogether suitable national designation. Perhaps the name most commonly used has been Nestorians; but this is a religious name. In the past, at least, many Nestorians were of other races, and large numbers to-day are not Nestorian at all. The name Assyrian has also been used, but never by the people themselves. It depends upon a historical hypothesis that is very likely correct, but which is not capable of absolute proof. The people call themselves *Surayi* or *Suryayi*, and the name Syrian is therefore the natural one to use, though it is objectionable on account of the confusion likely to arise from its connection with the country of Syria. This may be partially obviated by using the term Eastern Syrians.

Their origin is an interesting and obscure historical problem. We may dismiss at the outset the attempted identification with the Ten Tribes of Israel. This theory, which was started by the pioneer missionary Dr. Asahel Grant, has, in the minds of some, invested the people with a fictitious, sentimental interest. It is based on a supposed tradition among the people themselves and upon certain resemblances in customs to the Jews. The alleged tradition, however, is very infrequently met with, and nothing in Syrian history supports the conjecture. The data on which to base a theory are tradition, language, monuments, and literature. The Syrians living in Persia appear, whenever they have any tradition

on the subject, to say that their ancestors were immigrants from some other locality, and generally from the Kurdish mountains, very commonly either Jilu or Shemisden. In a few cases tradition points to emigrants from Maragha, on the eastern side of Lake Urumia. The Syrians living in Turkish Kurdistan have traditions of various migrations from one district to another within the general region, showing that the population has shifted in the past centuries. The most ancient centres of population—*i. e.*, the points from which migrations seemed to have emanated largely—are Jilu and Tiari. One also finds a widespread tradition that their ancestors came from the plain of the Tigris, in the region of Mosul and Arbil; while, so far as I know, the Syrians of the Assyrian Plain have no traditions of immigration into that region. There is also a general belief that the mountains were entered for the sake of refuge from persecution. All speak the Syriac language, though the dialects used differ considerably, and all differ so much from the classical Syriac that scholars incline to the view that the spoken Syriac is not directly derived from the written Syriac of former ages. The Syriac centres of learning were Edessa and Nisibis, so that the literary Syriac was in agreement with dialects spoken west, and not east, of the Tigris, and in the old literature there are references to dialectical differences then existing. The dialectical differences of the spoken Syriac are reducible to a few groups. One is the dialect of the Tigris plain, with various subdivisions. Another is the dialect of the southern mountain districts, centering in Tiari, and including some branches within the region generally occupied by the third group. This group centres in Jilu, and includes the northern districts in Turkey and all of those in Persia. It will be seen that tradition and language agree in pointing out Tiari and Jilu as ancient centres of population. The monumental remains are all churches, and contain very few inscriptions. The age assigned by tradition to these churches is very unreliable. The old churches in Persia are not numerous, and none of them can be proved, I think, to be older than the Mongol period; and possibly none is even as old as that. The literature remaining in old Syriac has been too imperfectly examined to make it possible to speak dogmatically of the evidence contained in it as to the Christians of the regions we are considering.

The following facts are collected mainly from that treasury of Syriac lore, *Assemani Bibliotheca Orientalis*. The Nestorian Metropolitan bishopric of Azerbaijan does not appear to have been as ancient or as prominent as others within the present

bounds of Persia, or farther east, especially Khuzistan, in southern Persia, and Merv and Khorasan, in the east. The latter are mentioned frequently from the beginning of the Moslem era, but the first mention of the former is in the tenth century. It is altogether likely, however, that the Christian religion was introduced at an earlier date, for in the beginning of the ninth century Nestorian missionaries were very active in Dailam, Ghilan, and Moghan, to the east and north of Azerbaijan. When Tabriz and Maragha became capitals of the Mongol power the importance of this diocese in both the Nestorian and the Jacobite churches increased, and large churches in Tabriz, Ardebil, and Urumia, which have been converted into mosques, probably date from this period. The Nestorian episcopal dioceses of Urumia, Salmas, and Ushnuk are first mentioned in the twelfth or thirteenth centuries. That there were Christians in the Hakkiari district of the Kurdish mountains in Turkey is evident from the early references to the bishops of Baghash, the ancient Syriac name for the region; but there is no reason to infer that the diocese was considered important until the present line of patriarchs took refuge there in the seventeenth century. The most probable conclusion from these scraps of evidence would appear to be that the Syrian Christians living in Persia are mainly descendants of immigrants from what is now Turkish territory, that these immigrants came within the last three centuries, and that some are descendants of Christians who have lived in these regions for perhaps a thousand years. Those of Turkey are, similarly, the descendants of refugees from the Tigris valley and of Christians who have lived in the mountain districts, near the upper Zab, from very early times. These migrations have been caused by political conditions and by religious persecutions. The mountains have offered refuge from the anarchy that has so often devastated the plains of Nineveh, and the Persian plains have offered comparative quiet to the sufferers from Kurdish lawlessness. Ultimately, therefore, the Syrians of these regions are descended from the Semitic, Syriac-speaking people who lived in ancient Assyria, and are of the same race as the Syriac and Arabic-speaking Christians now living in the valley of the Tigris. Inasmuch as the present Christian population is the remnant of a much larger Christian body, which included some of Turkish and Kurdish race, it is likely that they are not purely Semitic; and to this fact may be due the rather large variety of physical types observable among them.

The Syrians may be divided, with respect to their political con-

dition, into four main groups: those subject to the Persian Government, the semi-independent mountain tribes that are partially subject to the Turkish Government, those living in mountain districts that are completely under Turkish rule, and the Syrians living in the Tigris valley. The last group we shall not notice further.

The first mentioned live in the three plains of Urumia, Salmas, and Sulduz, bordering on Lake Urumia, and in the three little plains of Mergawar, Tergawar, and Baradost, just under the lofty mountains that form the boundary between Persia and Turkey. The largest number are farmers, working the lands of the feudal nobility. The direct taxes paid by them are insignificant in amount, but the amount that goes to the landlords is excessive. In irrigated lands the amount paid by the farmer is generally two-thirds of the produce of grain fields, if the seed is furnished by the landlord, and one-half if he furnishes the seed himself. In lands not irrigated the rule is that the farmer furnishes his own seed and gives to the landlord one-eighth of the grain. Besides this, he has also to furnish the landlord a very indefinite amount of unpaid labour. This last, and the fines assessed by the landlord and the regular Government officials, with the bribes demanded by them, are the most prolific sources of injustice. The vineyards, which make up a large part of the wealth of the Christians, and contribute largely to its increase, are held by a tenure much more favourable to the cultivator. The raisins, which are the most valuable product of the vineyards, are exported to Russia, and, in lesser quantities, to western Europe, *via* Trebizond. A considerable number of the Syrians are masons and carpenters; but very few engage in trade, being, in this respect, in marked contrast to the Armenians, and also to the Syrians of Mosul. The most marked feature of their industrial condition, to which is due much prosperity and also much demoralization, is the wholesale migration of the men to Russia for temporary employment. Every year thousands of Syrians cross into Russia to find work. The development of Transcaucasia, with the building of the cities of Tiflis, Batum, and Baku, has created a demand for labourers, skilled and unskilled, and Syrian carpenters, masons, and day-labourers have found lucrative employment. Not a few, too, have become contractors and employers of labour, some on a large scale. The recently-completed Tiflis-Kars-Erivan railroad was built very largely by Syrian workmen and Syrian contractors, who are now looking forward eagerly to the extension of the line to the Aras river, and ultimately across the border into

Persian territory. Others find work as porters and water-sellers in various Russian cities. Hundreds more are small shopkeepers or itinerant peddlers. Another occupation is begging. The credulity, religiousness, and kindheartedness of the Russians make their country a peculiarly rich field for pious frauds, who travel all over that great land, from Kiev to Vladivostok, in various and shifting guises. Some are just arrived from Jerusalem, and display holy relics to enforce their appeals; others tell tales of Moslem oppression, which, very likely, have a foundation in fact; others simply beg their bread and small sums of money from door to door. The excursions of the more enterprising are not confined to Russia, nor, indeed, to any country. Some of them, as eye-witnesses, told queer tales of the fighting of the allies in Peking, and of affairs in Manchuria. The effect of such a life, separating the men for months and years from their families, and subjecting them to most demoralizing influences, may easily be imagined.

The mountain region between the upper course of the River Zab and the Persian border is very rugged, and contains only very deep and narrow valleys, except the lofty plain of Gawar. These valleys are inhabited by Kurdish and Syrian clans that own their allegiance to the Sultan within their mountain country only by paying an irregular and very inconsiderable tribute. Disputes between individuals and communities are settled by a primitive code of tribal law, enforced by the strong arm of the people themselves. Their wealth consists almost entirely in sheep, and these are the objects of frequent inter-tribal raids. Unlike the Kurds, none of the Christians are nomadic, although they spend the summer months as much as possible in the mountain encampments, where the sheep are kept. The narrow valleys are terraced, and so fields are made, which are sown with millet, Indian corn, potatoes, and other products. The fields are popularly measured by the number of hatfuls of seed required to sow them. In some of the valleys rice is also cultivated to a considerable extent. The people of Tiari seldom go out of their own territory, but in the other districts an industrial condition obtains not unlike that already described. Instead of going to Russia for work, the men go for the winter to the plains to the south and find work in the large cities, from Mosul to Aleppo and Damascus, especially as stonemasons and basket-makers. Some, again, are vagrant beggars. One village in Jilu supports itself almost entirely in this way. It would be hard to find anywhere another such community as this village of Mar Zaya. In a most picturesque and rugged valley, in the shadow of a massive old church, reputed by

tradition to be fifteen hundred years old, apparently shut off from the world as completely as in a prison, one may hear the men tell of their adventures in every part of the world—Australia, America, China, Africa, and Europe. In order to show that this is in no way exaggerated, let me add that the present writer has seen letters from or concerning these men from Austria, England, America, Dahomy, Cape Colony, India, and South America. In general, it is impossible for these communities, living in such rugged regions, maintaining a precarious independence of Government control, and constantly embroiled in tribal wars with each other and with the Kurds, to prosper in material resources.

Most miserable of all are the Syrians living in or near the mountain districts under more complete Government control. During the past fifty years the Turkish Government has gradually extended its authority in the mountain districts. The power of the great Kurdish chiefs has been broken, and, one after another, districts have become *rayat* instead of *ashirat.* The result ought to be increased security and prosperity; but, unfortunately, it is not. Taxation is heavier than before, and is strictly enforced, the intricate procedure of law courts is substituted for the rude and summary process of revenge, the towns are garrisoned with disciplined troops, but the Kurdish robber is as rapacious, if less conspicuous, than before. The consequent state of affairs is deplorable in the extreme, and not a few districts are becoming depopulated of Christians. In general, the industrial condition is most wretched. Many, of necessity, become beggars in the more prosperous Christian villages of Persia or the Tigris valley, or they obtain Persian passports and wander off to Russia. Many an old church, either deserted or sheltering in its shadow a handful of wretched people, bears mute but eloquent testimony to former and happier days.

As a whole, the Syrians have not been slow to avail themselves of opportunities to improve their condition; and it may confidently be expected that in the opening of the projected Bagdad railroad they will profit far more than the Kurds and Arabs of the regions traversed. Both in Turkey and in Persia the Governmental conditions are growing worse with time; but even more rapidly the Christians are growing in sensitiveness to wrong as they grow in intelligence. From this, more than any other cause, arises the desire to emigrate, and each year families remove to Russia, and the tide is beginning to flow towards America as the freest of all lands.

Without making any claim of more than approximate accuracy, it is believed that the following estimate of population is not far

from the truth. It is based on lists of villages and numbers of families, derived in most cases from more than one source, either from intelligent natives or from missionaries who have travelled through the regions under consideration.

I. PERSIA:

Plain of Urumia............	90	villages.	4,900	families.	24,500	souls.
" " Sulduz............	8	"	100	"	500	"
" " Salmas............	4	"	400	"	2,000	"
" " Tergawar..........	18	"	800	"	4,000	"
" " Mergawar..........	6	"	100	"	500	"
" " Baradost..........	2	"	50	"	250	"
	128	"	6,350	"	31,750	"

In the above the families have been reckoned as containing five heads in each one. Below they will be reckoned at seven each, as there is far less division of sons from their father or brothers from each other among the mountain than among the plain Syrians. In many villages in Persia the Syrians live beside Moslem neighbours; but in Turkey this is rarely the case, and the villages are entirely Christian or entirely Moslem.

II. TURKEY—SEMI-INDEPENDENT TRIBES:

Jilu......................	14	villages.	555	families.	
Baz.......................	7	"	375	"	
Diz.......................	11	"	170	"	
Tkhuma....................	5	"	750	"	
Tal.......................	6	"	230	"	
Tiari.....................	40	"	1,720	"	
	83	"	3,800	"	26,600 souls.

III. TURKEY—DISTRICTS UNDER GOVERNMENT RULE (RAYATS):

Region of Gawar...........	21	villages.	680	families.	
" " Bashkala and Van.	22	"	520	"	
" " Julamerk........	10	"	200	"	
Nochea, etc. (near Persian border south of Gawar)...	15	"	270	"	
Rakan, Chal, etc. (north of Zab, near Amadia)........	14	"	310	"	
Region around Amadia south of Zab..................	45	"	1,205	"	
	127	"	3,185	"	22,295 souls.

These figures give a total of 338 villages, 13,335 families, and 80,645 souls, to which may be added some 30,000 living in the valley of the Tigris, making a total of about 110,000 souls, though I cannot vouch for the correctness of the figure for the Tigris valley.

THE MISSISSIPPI RIVER FROM CAPE GIRARDEAU TO THE HEAD OF THE PASSES.*

BY

ROBERT MARSHALL BROWN.

Occurrence of High-Water Stages.—The early floods of the year come mostly from the eastern rivers, and usually culminate in March; while the western rivers generally cause a flood in June. An intermediate rise in May is not uncommon when a late rise of the eastern tributaries coincides with an early rise of the western. Great floods occur at intervals. The following table estimates the average conditions (Reports '83, 26):

STATION.	YEARS.	FLOODS.	HEIGHT OF FLOODS EXPECTABLE ONCE IN 10 YEARS.
Cairo...........	1862–1883	4 reached 50.8 ft.; highest, 52.4	51.5
Memphis........	1858–1883	6 reached 34.0 ft.; highest, 35.2	34.5
Helena.........	1867–1883	6 reached 45.8 ft.; highest, 47.2	46.5
White River....	1862–1883	5 reached 46.6 ft.; highest, 48.5	47.5
Vicksburg......	1858–1883	4 reached 48.8 ft.; highest, 51.1	49.0
Natchez........	1858–1883	5 reached 47.9 ft.; highest, 50.3	48.0
Red River......	1867–1883	3 reached 46.3 ft,; highest, 48.6	47.0
Carrollton......	1859–1883	5 reached 15.9 ft.; highest, 15.9	15.6

Cause of High-Water Stages.—The most potent agent in producing floods in the Mississippi has been excessive rains. The waters of the river come from three main sources—the Missouri, the Ohio, and the Upper Mississippi. These rivers are placed in a table for comparison:

RIVER.	DRAINAGE AREA IN SQ. MILES.	AVERAGE ANNUAL RAINFALL.	% OF RAINFALL DRAINING OFF.	% OF TOTAL DISCHARGE OF MISSISSIPPI SUPPLIED.
Missouri..........	541,000	20.9 in.	15	14
Ohio..............	202,000	41.5 in.	24	31
Upper Mississippi.	171,500	35.2 in.	24	18

The Missouri area has its rainfall in May and June, and is a cause of the late floods of the Mississippi. Although the Missouri has the largest drainage area, yet, because of the scant rainfall and

* Concluded from Bulletin No. 5, 1902.

the small percentage of run-off, due to an absorptive soil and drying winds, it is hydrologically the least important. It contributes only 14% to the total discharge of the Mississippi. It, however, contributes 60% of all the solid matter borne by the river. The Ohio valley has its heaviest rains in January, February, and March. Its largest tributaries, the Cumberland and the Tennessee, rise in the mountains, and have a copious rainfall, which adds enormous volumes of water to the Ohio. The Ohio is in the track of the storms which come from the Gulf; and although its basin is less than one-half of that of the Missouri, it furnishes over twice as much water to the Mississippi. Melting snow and frozen ground are factors in this large percentage. The Upper Mississippi has its heaviest rainfall in May and June, and its rises unite generally with those of the Missouri. These three rivers yield 63% of the total discharge of the Mississippi. The remaining 37% of the discharge is divided among the other tributaries. The St. Francis, White, and Arkansas Rivers, draining the Ozark plateau, contribute about as much water as the Missouri. The Yazoo and Red Rivers, the remaining large tributaries, are too near the mouth to be dangerous.

The ordinary sequence of floods is, first, Ohio, then the Upper Mississippi, followed by the Missouri, with the western streams. All these rivers have never been known to be in extreme flood at once. Such a coincidence would produce a discharge of more than 3,000,000 cubic feet per second—twice as large as has ever been observed. The most dangerous conditions occur in early spring, accompanying the cyclonic storms which cross the country.

While excessive rains are the prominent cause of floods, a number of factors influence their value.

a. Condition of ground, whether frozen or vegetation-covered.

b. Condition of ground as to moisture. A slow rainfall of two inches extending over three days may produce only a very slight rise in a river, while the same amount in two hours may produce a very great one. A rapid rainfall forms a water surface over the ground, which promotes a rapid transfer of a great part of it to the stream. In summer the ground is so dry that in a slow rainfall there is little run-off.

c. Height at which the flood finds the lower trunk.

d. Duration of rise. A sudden rise up river flattens out as it proceeds down stream.

e. Local rainfall in the lower valley.

f. The clearing of forests has been shown (Russell, I. C., '98, 209) by experiments to have no direct effect in increasing river

stages. The increase in erosion, however, following the removal of vegetation, may so increase the load of a stream that disastrous floods result.

EFFECTS OF HIGH-WATER STAGES.—The increase in the power of the river during times of flood intensifies the scouring and cutting of the banks and precipitates cut-offs. The great disasters of floods come from the occurrence of crevasses and the discharge of the water over the surrounding country. The territory subject to submergence consists of certain basins along the river—the St. Francis, 6,706 square miles; White River, 956; Yazoo, 6,648; Tensas, 5,370; Atchafalaya, 8,109; and Pontchartrain, 2,001; aggregating 29,790 square miles. These rich bottom lands offer exceptional advantages to the pursuit of agriculture, and only as those already occupied continue to be populated, and others, sparsely settled because of the risk, increase in population as the danger is checked, can the great expense (for levees alone estimated in 1898 at $34,310,795.34, with $18,000,000 needed to complete the system) be justified.

The 1897 flood was considered an exceptional flood; 13,000 square miles of the basin lands were submerged, and the destruction of live stock and crops caused a loss of some $13,000,000. In comparison with the 1882 flood, the waters of the 1897 flood were 22 days less above the danger line. It was remarkable, however, in that it remained a longer time at its highest stage. A comparison of the two floods is interesting.

STAGE OF THE RIVER.	1882.	1897.
River above danger line	81 days.	59 days.
River 2 feet above danger line	68 days.	56 days.
River 4 feet above danger line	63 days.	51 days.
River 6 feet above danger line	47 days.	47 days.
River 8 feet above danger line	15 days.	42 days.
River 10 feet above danger line	9 days.	19 days.

A flood moves as a wave down the stream. T. Russell states ('95, 211) that the wave moves with a velocity dependent on the slope of the river and the mean hydraulic depth, and does not differ a great deal from the velocity of the water. It is probably much slower. The crest of the 1897 wave showed on the hydrographs a progress from Cairo to Carrollton, 270 miles, at an average rate of 1 foot per second, while the average velocity of the river varies from 2 to 5 feet per second.

The difference in height between high and low water at St. Louis

is 37 feet; this increases to 51 feet at Cairo because of the Ohio; it then, with slight fluctuations, gradually decreases in amount until at the Head of the Passes the difference between high and low water is but 2.3 feet. The flood loses its power as it goes down stream, and a long river, therefore, cannot have a disastrous flood in its lower courses. The crest of the wave spreads out, and is, therefore, self-destructive. Reference to Figure 9 will show that from the crest A to B the water will have a tendency forward equal to its normal flow under a similar volume, and a normal slope *plus* the impetus due to gravity because of the height of the crest. On the other hand, from C to A is up the back slope of the crest, and a retardation of the waters occurs. In this manner the water is spread over a larger area as it progresses down stream.

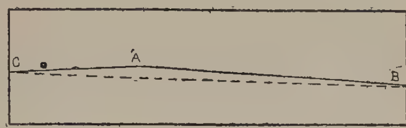

Fig. 9.

Prevention of Floods.—*a.* By Reservoirs: The country about the headwaters of the Mississippi is peculiarly adapted to the construction of reservoirs. Many persons have maintained that the excessive floods in the river may be mitigated by the retention of a considerable portion of the waters of the larger tributaries until a time of lesser flow. But, inasmuch as destructive floods are often dependent on favourable local conditions, as, for instance, the floods of a swollen tributary superimposed on a swollen river, unless the reservoir system is widely extended its appreciable effects will be small. Its extension to an efficient means of preventing floods is chimerical. Starling has recorded ('97, 2–4) that, to reduce the floods of the Mississippi 1 foot for 2 months, 13 reservoirs, each 110 feet deep and 7 square miles in area, would be necessary.

b. By Outlets: Another scheme to retard the height of floods is to provide more outlets for drainage. Considerable uncertainty prevails among the engineers as to why the outlet plan cannot be recommended, but they are united in the belief that no relief from flooded conditions can be looked for from them. No single outlet could suffice, and the Lake Borgne outlet, so urgently advised at one time—if the water could be induced to flow into the lake—would soon be shoaled by sediment. It has been shown that disastrous floods do not occur in the lower reaches, so the only effect an outlet would have that might be valuable would be to accelerate the velocity of the river, and thus decrease the time of water above

the danger line. Outlets, where they are needed between Cairo and Vicksburg, might be of great utility; however, the relief of the river at the expense of flooding the back swamps and bottoms destroys the purpose of levees. Crevasses occur as natural avenues of relief. The Nita Crevasse of 1897 discharged 30 per cent. of the entire waters of the river, but fifty miles above the break the height of the flood was not visibly affected.

c. By Diversion of Tributaries: No such works are practical except at enormous expense; and even if money was available, the injury to navigation which would surely result would forbid the execution. Furthermore, there is a question concerning the efficiency of the plan. The Po is quoted (Reports, '90, 3,093) as a river on which the opposite plan, addition of tributaries, was tried with good results. In 1600 the Panaro River, almost the equal of the Po, was joined with the latter; and in 1720 the Reno was added to its tributaries. The increased volume of water, and the consequent increased velocity of current, is reported to have caused the Po to deepen and widen its channel, and the liability to overflow was greatly diminished.

d. By Levees: The first levee on the Mississippi was built in 1717, at New Orleans, to protect that city from an overflow. This levee was a mile in length. The mileage of levees to-day is 1,300. The height of the 1717 levee was 4 feet. The average height of the Louisiana levees to-day is 12 to 13 feet, and they were hardly sufficient to hold the 1897 flood. The object of the levees is to confine the water of the river within certain narrow limits, and thus prevent the swamping of the valuable bottom lands on either side of the river. South of Baton Rouge there are 40,000 square miles of made land, of which 36,000 can be reclaimed for cultivation, and be valued at the rate of $30 per acre at $690,000,000. The restraining of the river from spreading over the alluvial plain and banking it within narrow limits must place the surface of the floods at higher and higher levels. While a local 4-foot levee sufficed in a river otherwise free to spread, a much-leveed river breaks over a 12-foot levee. The continual increase of the height of the levees is necessary, not because of greater floods, but because of the closer confinement of the waters. Figures of the heights of levees often show a great increase over the former ones, but in many cases the increase is due to the position on the flood-plain. The caving away of the high alluvial banks has forced the building of levees on the ground of the back slope of the flood-plain. Where a levee 5 feet high met the

demands in 1874, now a 17-foot levee is needed; the top of the levee, however, is not much higher than before, while the bottom is 10 feet lower.

There has been assigned for the continual increase in levee height another cause—*i.e.*, the rise of the river bed. Investigations on the Po, the Rhine, and the Mississippi show that the bed is scoured out if anything happens during the increasing height. The extreme low-water surface of the Po increased 1-50 of a foot per year, and the measurements are doubted, while the low-water surface of the Rhine and the Mississippi appears to have fallen. In any circumstance little change is apparent. Another objection to levees is that the prolongation of the delta by deposition of sediment will cause an ultimate rise of bed and a future necessary increase in the height of levees. This objection has been answered by calculations which show that in one hundred years the flood height at New Orleans will rise an inch from this cause.

The location of levees is a serious problem. In the eight years subsequent to 1866, 107.5 miles out of 800 miles of levee caved in, in the State of Mississippi. The immediate banks are not, in general, a safe foundation, as undercutting is possible. The levees must always present to the flood a smooth front, sharp salients being avoided. Where caving is excessive, a double system of embankments is recommended. The causes of the breaks in levees include:

a. Insufficiency in height. The criterion for height has been the highest known water-mark. The increased construction, as has been shown, demands higher and higher levees. Crevasses have been common occurrences; and as the efficiency of levees increases and crevasses become less the rule, the standard height will be attained.

b. The stirring of a full river into action by winds. The March floods, accompanied by high and persistent winds, are much dreaded.

c. Unsoundness or faulty construction. Here may be placed insecure or treacherous foundations and injudicious cross-sections.

d. Maliciousness. There have been recorded—strange to say—breaks that result from a desire for revenge, because of a private hostility against a wealthy planter. Again, landowners, under the threatening break and destruction of their own property, have relieved the strain by opening the levees on the opposite bank. The swampers, who in the dry season cut timber for the market, and who have depended on the overflow to raft their logs, have

claimed that the levees were injurious to their business. Breaks have been attributed to these men.

e. Burrowing of animals.

The increasing efficiency of levees is attested by the following table:

In 1882, 284 crevasses occurred, aggregating 59.09 miles.
In 1883, 224 crevasses occurred, aggregating 34.1 miles.
In 1884, 204 crevasses occurred, aggregating 10.64 miles.
In 1890, 23 crevasses occurred, aggregating 4.25 miles.

The flood of 1890, which was one of great height and duration, was experienced with 80% of the bottoms free from flood. The 1895 flood in Louisiana was so efficiently restrained that 85% of the territory (15,000 square miles, with property valued at $180,000,000) was protected against complete inundation, and a loss of only 1-6% of the length of the levees was recorded.

Low-Water Stages.—The following table (Humphreys and Abbot, '61, 122) gives a comparison between the average high-water dimensions and the average low-water dimensions of the river:

LOCALITY.	SECTIONAL AREA.	WIDTH.	MAXIMUM DEPTH.
	High Water.		
Ohio to Arkansas River......	191,000 square feet.	4,470 feet.	87 feet.
Arkansas to Red River.......	199,000 square feet.	4,080 feet.	96 feet.
Red to Bayou La Fourche....	200,000 square feet.	3,000 feet.	113 feet.
Bayou to Head of Passes.....	199,000 square feet.	2,476 feet.	129 feet.
	Low Water.		
Ohio to Arkansas River......	45,000 square feet.	3,400 feet.	49 feet.
Arkansas to Red River.......	54,000 square feet.	3,060 feet.	56 feet.
Red to Bayou La Fourche....	100,000 square feet.	2,750 feet.	78 feet.
Bayou to Head of Passes.....	163,000 square feet.	2,250 feet.	114 feet.

Below the Red River there is the least range between the two stages of the river, and sixty-six sections give as the ratio between the high-water and low-water widths 0.91. Above the Red River the variations between the high and low water widths do not vary so regularly, but one hundred and thirty-eight equidistant measurements on the river, from the Ohio to the Red River, yield a ratio of 0.74. The table, however, does not adequately express low-water conditions. As far as navigability is concerned, that is measured, not by the average low-water dimensions of the river, but by the

extreme low-water dimensions. The high-water stage is the ruling condition when the bed is shaped and defined. Great masses of sand are carried by the swollen stream and deposited as bars in the channel. The approach towards low water finds these bars a menace to navigation. Back of the bars the water is ponded, and the river bottom presents a series of pools and shoals. As the fall of the water continues, the ponded water breaks through the bars and forms the low-water channel. The formation of this channel, fitted for navigation, depends upon the rate of decline from a high to a low stage. A slow, gradual decline is beneficial. Anything that will reduce the rapidity of the fall from the higher stages is, therefore, desirable, and in this line reservoirs may find a place. Were it not for the magnitude of the task, reservoirs might be constructed to the advantage of the low-water stage in two ways. By slightly reducing high water—always considering the difficulty of knowing what fall of rain to hold in the reservoir—it would lessen the shoaling of the river, and, during the fall of the water, by judicious feeding, a steadiness of volume could be maintained in the river. Lakes and swamps act continually as reservoirs to lessen floods and also to increase the low-water discharge. The argument that drainage and reclamation of swamps and wet lands affect the river flow can find some justification in the consideration of the low-water discharge—that as the natural reservoirs are removed the low-water discharge will diminish and the low-water channel will not be cut out sufficiently to insure a continuous passage. Against all this the main river finds some protection in the extent of its basin and the number of its tributaries. Poor low-water channels are generally found with excessive low-water widths, and a cure for this has been proposed by the Commission by contracting the low-water width to about 3,000 feet. This contraction must result from works in the bed of the river, and not from levees on top of its banks out of contact with the low-water river.

River Correction.—German engineers have advocated and put in execution the plan of river correction in order to solve the problem of a large meandering stream. The Rhine, from Strassburg to Mainz, has been corrected, and is to-day a stream flowing along curves of a large radius, sharp enough to give the river a swinging habit, but not so sharp that the tendency to scour the banks is unmanageable. It is strange that no strong effort of this nature has been seriously advocated by the Mississippi River Commission. The problem demands careful preparation, and should be approached

in accordance with correct hydrotechnic principles. In the testimony before the Senate (The Mississippi River Floods, '98, 296–9, Plate 20) a single witness urged the correction of the Mississippi in preference to all other methods, but the map showing the location of the proposed channel was, on the face of it, so irrational as to make the witness's advocacy of the plan of little worth. The natural shape, conditions, and tendencies of the river should be conserved to the greatest extent consistent with the requirements of commerce. The entire energy of the engineers seems to be centred on the completion of the levee system. It is impossible, with the sharp bends in the river, to prevent caving. It can hardly be expected that the levees will serve their purpose effectively so long as bends similar to the Greenville meanders menace any construction.

New Bedford, Mass., 1902.

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VARIETIES OF TIDES.

BY

ALEXANDER BROWNLIE.

The Red Sea Variety.

In the consideration of our subject thus far, the frequent failure of flood-tide forms the distinctive feature in each case, but in the case of the Red Sea it is not so. At Aden, the standard port for reference for the Red Sea, the prevailing type is semi-diurnal; but there are a number of days throughout the year in which only one high water occurs, and an occasional day in which there are none. This variety also differs from all the others in respect to its environment, for it is furnished with only one line of communication with the ocean, the Strait Bab-el-Mandeb. This strait is 13½ miles wide, but in it lies Perim Island; the wider channel is 10 miles wide, and the sounding line shows that it is close upon 200 fathoms in depth.

Through this deep but comparatively small channel all the power is transmitted which operates tide in a sea fully 1,200 miles long by 200 in the widest part. At Perim Island the mean rise is 5 feet 3, and the highest waters range fully 2 feet higher. At Suakin (in the widest region) the mean is only 1 foot 3, and extremely uncertain tides both in time-intervals and height of rise prevail all through the wide region; but in the Gulf of Suez, at Suez, they range from 4 to 7 feet. This gulf has a length of 170 miles, with an average width of 30.

So the Red Sea possesses a very large region of small tides in the centre and small regions of comparatively high tides at either end. Although the opening at Perim is so small, yet the tidal energy is so great after passing the centre that floods are forced up as high at Suez as at the opening. This fact seems to be accounted for by the straight course of the sea, in which there is no barrier to deflect and weaken the direct force of the pressure; but it is not so with the Gulf of Akabah, for that gulf is not only barred at the entrance, but it lies at a considerable angle off the line of pressure; hence in it the floods are fully 2 feet lower than at Suez.

At Aden the time-intervals range as wide apart as 9 hours to 16

* Concluded from Bulletin No. 5, 1902.

from one high water to another. According to the forecasts for this port, the rise at times is as high, and even higher, at the quarters than at the new moon or full. For example:

DATE.	PHASES OF MOON.	PREDICTED RISE OF TIDE.
Jan., 1900....	Full	6 feet 5
" " ...	1st Quarter............	6 " 7
June, "	3d Quarter	6 " 7
" "	New..................	6 " 7
July, "	Full	6 " 8
" "	3d Quarter	6 " 9
" "	New..................	6 " 4
Aug., "	3d Quarter	6 " 6
" " ...	New..................	6 " 6
Dec., "	New..................	6 " 8
" "	1st Quarter............	6 " 8

According to the science of the tides, if the moon can raise the floods at Aden 6 feet in height at new moon or full, then at the quarters it ought to raise them 2 feet only; and according to the U. S. Tables for 1902 for Aden in January, February, June, August, September, and December tides are predicted to rise as high as at new moon or full from five to nine days *before* or *after* new moon or full. Now, this is also contrary to the fundamental laws of the lunar science.

With regard to that most striking feature in all variation—days in which flood-tide fails to rise—Mr. Darwin says:* The Royal Engineers made a series of predictions for Aden covering some two months, then they followed that up by an observation of their forecasts, which resulted in the discovery that one predicted flood failed to appear.

The forecast being made and recorded, of course there was no failure there.

The failure lay with the sea itself; it did not rise at the time the engineers predicted that it would rise.

Possibly this occasional failure may throw a new light upon a very old subject—the celebrated historical incident connected with the escape of Israel from the bondage of Egypt; for it is quite within the range not only of the possible but of the actual that the freaks of this variety were known by the leader of Israel, for he had

* The Tides, p. 245.

spent forty years of his life in Egypt and forty years in the desert over against Egypt.

Was he not learned in all the wisdom of the Egyptians? The historian of the times tells us that the march at first was not directed in a bee-line to the desert of Sinai, but along the border of the sea, and on the Egyptian side of it, into what seemed a natural trap, where, seemingly, it would be easy work to capture them, when, lo! at the dread moment, when capture was nigh, one of the floods failed to appear, and with the opportune moment came the order to change the march from south to *east.* It was a night march. But did Israel march dry-shod across the sea? Nay, across a dry shoal, which the Egyptians also essayed to do, when, lo! a six or seven foot flood came rolling along, and, in the words of the ancient war song, celebrating the victory,

They sank in the depths like a stone. *

The historian also gives the important information that at the time of crossing

A strong east wind blew all night and made the dry land. †

In our own times it is even now a matter of fact that the height of floods at Suez is frequently controlled by the wind, and the greatest difficulty to modern navigation arises from the prevailing northeast wind.

It is also a matter of observation that floods flow from the sea into the canal for about seven hours, while ebbs flow out for about five. The modern harbours, also (some two miles south of Suez), are separated from that town by "a shoal which is dry at low water." ‡

At an early period in the history of the Red Sea the Gulf of Suez penetrated farther north than at present. The evidence is quite clear that it once covered a series of depressed shallow vales, whose surface was coated with a deposit of salt, which had all the appearance of a covering of snow.

That was previous to the opening of the canal; but by the opening of the canal these former salt vales have been transformed into salt lakes, the largest of which, the Bitter Lakes, extend some twenty-three miles in length.

Such an extension of narrow sea provides a reason for the march *south*—of Israel—at the start, and it also provides a natural way,

* Exodus XV.

† Exodus XIV, 21.

‡ Encyclopædia Britannica, Vol. XXII, page 620.

a shoal at ebb tide, to make good their escape; but in unison with these was the natural agent expressly named by the historian:

> A strong east wind made the dry land, and the waters were divided.

That is, the shoal divided the waters of the lakes from those of the gulf.

Double Tides in the English Channel.

This variety of double tides has long been the subject of scientific speculation in France and Great Britain. With regard to it, Lord Kelvin said *:

> "In Portland Harbour, sometimes, the water rises, sinks, seems to think about it, and then rises again. This harbour has a double low water. Southampton has a double high water, and the double high water seems to extend across the Channel, for there is a double high water at Havre Bar. At Southampton the water remains high three hours, then dips a little. It then rises for one and one half to two hours before falling to low water.

The cause of these remarkable tides was no less a riddle to the distinguished lecturer than to his distinguished hearers, for some observers had said that the Isle of Wight was the cause, while others found it in the Strait of Dover. But it was the opinion of the lecturer that the small Isle of Wight could not cause the remarkable disturbances both at Southampton and Havre; and in this reasonable conclusion we agree.

In order to make a reasonable explanation of all the freaks of this variety, we ought to discover the cause in the larger geographical environment of the whole Channel itself, for the smallness of area in the two places named is altogether insufficient to account for the greatness of area affected by the disturbances. The eastern end of the Channel is suddenly contracted from a width of about seventy miles to one of twenty in the Strait of Dover, but between Southampton and Havre the width greatly exceeds seventy miles. Now, the comparatively insignificant area at Dover is absolutely insufficient to account for the disturbances at Southampton and Havre. On the other hand, at the time of flood-tide, in the eastern end of the Channel, the smallness of the Strait is also absolutely insufficient to relieve the pressure; consequently only a small portion of that flood finds an outlet through the Strait, and the great bulk of it flows back to whence it came in the succeeding ebb. And, by the pressure of that returning ebb, we find the solution for some of the details of the problem, but only some, because the balance is explained by the fact that a large area of the eastern end is co-tidal, and we call it the English Channel basin.

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* Lecture to the British Association at Southampton, 1882.

On the French side of the eastern end flood-tide continues to press onward for about one and one half hours after Havre is supplied, so the co-tidal basin continues to receive that pressure for that length of time after the level has ceased to rise on the English side.

When the ebb from the basin sets westerly, it takes about one and one half hours to return to Havre Bar; consequently that return pressure causes a second rise on the bar. But the second rise is also partly due to the environment of the peninsula west of Havre, for it bars the way of the receding ebb. So this explains the riddle of the double tides at Havre Bar.

Upon the English side the Channel basin remains at the condition of high-water level for the remarkably long period of three hours, and that basin extends from about Southampton to the neighbourhood of Dover. The long duration of high water in the basin is partly explained by the longer duration of supply on the French side; and on that side, be it observed, the supply is also much greater in bulk. For instance:

FRENCH SIDE.	MEAN RISE.	ENGLISH SIDE.	MEAN RISE.
Havre	17 feet 3	Southampton	9 feet 9
St. Valery en Caux	20 " 6	Portsmouth	10 " 2
St. Valery sur Somme	22 " 0	Newhaven	15 " 3
Boulogne	19 " 4	Hastings	18 " 3
Calais	16 " 2	Dover	15 " 2

Observe that the rise at the St. Valerys is double that at Southampton, and at Havre it is also considerably higher than that at Portsmouth. The long duration of flood at high-water level in the Channel basin is due not only to the continuous pressure at the French side, but also to the fact that east of the Strait of Dover, in the North Sea, the English Channel flood-tide encounters the pressure of the North Sea flood. The two pressures block and balance one another, and thus form the English Channel basin by keeping it at high level for the long space of three hours; but at the expiry of the three hours the "little dip" of Lord Kelvin occurs, because the pressure of flood in the co-tidal basin is then relaxed, and from its higher level above the level at Portsmouth and Southampton the ebb from the basin in its passage westward has the effect of a second flood, because *it flows from a higher level to a lower.* So in its passage by Southampton it causes a second rise there; but when the passage is effected, then occurs the fall to low-water level, and that explains the riddle so far as Southampton is concerned. By the time the ebb arrives at Portland harbour it is the time of first low water there,

and the pressure is still sufficiently strong to keep local sea-level steady for a while; but when that pressure is relaxed, then the water falls to the second low level. And that explains his Lordship's riddle in full; and, so far as we know, for the first time.

The principle of geographical environment, whether applied to small seas or great, ought to give a reasonable explanation of all tidal variation; whereas "the power of mathematics," the specific solvent of lunar science, "fails totally in the attempt to express the transmission of tide waves."* "The irregular distribution of land and water and the variable depth of the ocean produce an irregularity in the oscillations of the sea of such complexity that the rigorous solution of the problem is beyond the power of analysis." † Now, why should mathematical analysis be considered the only method to be used in finding out a problem in geography?

Men usually unravel such problems by *sight*, and not by mathematics! Nobody finds that the oceanic currents are due to the influence of the moon. Why, then, should the action of the tides be considered due to the action of the moon? The answer is, because a wrong method was applied to solve the problem at the first, and that wrong method was begun when no man knew aught of the tides of the world! They also, at first, used a wrong method of looking at the movements of the air. Not so long ago all men believed that changes in the weather were caused by the changes of the moon. There existed a lunar weather science down to about the middle of the nineteenth century. We have since turned from that kind of moon-weather science; and it is merely a question of time when the geographical principle will be accepted as the only right principle to solve every tidal problem instead of the moon-tide solvent, mathematics—an absolutely impotent solvent, and acknowledged to be such by Mr. Darwin himself. ‡

In this article we have already called attention to the fact that even the North Pacific Ocean is only one of the varieties. Still more evidence in proof of that remarkable fact is furnished by M. Elisée Reclus. In one of his books he cites the failure of expected flood-tides, which never appeared at all at Petropaulovski.** And in that ocean we have also showed that high and low water take place on the same meridian! ††

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* Sir Geo. Airy, Johnson's Cyclopædia, Vol. IV, p. 1699, 1st edition.

† Prof. Geo. H. Darwin, Encyclopædia Britannica, Vol. XXIII, p. 355.

‡ The Tides, p. 188.

** New Physical Geography, Vol. 2, page 93.

†† April, 1902, Bulletin Am. Geographical Society, N. Y.

Now, according to the lunar science, neither the failure of floods nor the meridian high and low water ought to be possible in the Pacific Ocean. But the fact of their occurrence in the very ocean where tides are supposed "to be most normal," and to respond more accurately and quickly to the supposed "pull" of attraction, is the impregnable proof of the absolute failure of that science.

And no wonder, for the modern masters of that science—Whewell, Airy, and Darwin—based it upon "an almost total ignorance" of the tidal conditions of the Pacific Ocean.* Nevertheless, Airy and Whewell removed the seat of lunar attraction from the equator—where it had been placed by the old masters—to the South Pacific Ocean. So, then, the new departure instituted by them is not based upon evidence, but upon an admitted ignorance of the actual tidal conditions at the "cradle of the tides"—the "cradle" from whence globe-travelling waves are supposed to supply flood-tide to all the earth!

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* The Tides, p. 189.

THE PANAMA CANAL.

BY

GEORGE S. MORISON.

Many other routes have been proposed for isthmian transit, but in every instance, before much actual work has been done, the selection has finally turned to Panama, the successive choice of which by the Panama Railroad Company, by the Congress of Paris, and by the Isthmian Canal Commission confirms its merit.

FIG. 1

In no one respect can the Panama route be considered the best. For convenience of access to all ports except those of South America, Tehuantepec is superior, but a summit 700 feet above tide water, too broad to tunnel or to cut through, makes it an impossible canal route. The San Blas route from Mandinga harbor, on the Caribbean side, to the mouth of the Chepo, in Panama Bay, has the best harbors, and is the shortest line between the two oceans; but the summit is four times as high as that at Panama, requiring a tunnel more than four miles long, which is fatal. The Nicaragua route has the lowest summit and the attractive feature of a great inland lake for its water supply. It is a practical route for a canal;

but the distance between the oceans is four times as great as at Panama; it is near the region of maximum volcanic disturbance; there are no existing harbors at either end, and for a distance exceeding the entire width of the isthmus at Panama the Nicaragua Canal must be built through a nearly uninhabited swamp, with a rainfall of over 200 inches a year, where the newly-upturned soil would be full of malaria; and this only brings it to the San Juan River, whose crooked channel must be improved and made navigable. There are three possible routes from Caledonia Bay to San Miguel Bay; the distance between tide water on each of them is about the same as at Panama; there are good harbors at each end; but all of these routes involve tunnels, although on one of them the summit is but little more than 600 feet high, and on another the length of tunnel can be kept within two miles. Various routes have been proposed between the Atrato River and the Pacific, but all of these involve a considerable length of canal in the delta of a great silt-bearing river and a length of inland navigation much greater than on either the Panama, the San Blas, or the Caledonia routes. While not possessing any single feature better than that of some other route, the Panama route has many less bad features than any of the others. It is for this reason that it has been so often selected as the best trans-isthmian line.

The Atlantic terminus of the Panama Canal is at Colon, in latitude 9° 22′ N. and longitude 79° 55′ W. The Pacific terminus is Panama Bay, in latitude 8° 55′ N. and longitude 79° 31′ W. It is a somewhat singular thing that the course of the canal is from northwest to southeast, and the Pacific end is 28 miles east of the Atlantic end. The length of the canal from shore-line to shore-line is 43 miles, and from the six-fathom contour to the six-fathom contour 49 miles, which distances can be reduced about a mile and a quarter by a change of location which will be mentioned hereafter.

The mean levels of the two oceans are the same. There is, however, an enormous difference in tides, the tide in the Caribbean Sea being hardly more than nominal, seldom amounting to two feet; while the tide in Panama Bay often exceeds 20 feet. If a tide-level canal were built a lock would be required near the Pacific end.

Colon harbor, at the sea end of the Bay of Limon, is a fairly good harbor, which has answered the demands of commerce for fifty years. It is, however, barely 30 feet deep, and is open to the sea on the northwest. When a storm blows in from this direction all shipping must put to sea; but the number of days in a year in which this harbor cannot be used is very small. Panama Bay is

a great body of water with a number of islands in it, generally calm, and with abundant anchorage in protected locations; although a roadstead rather than a harbor, it answers all commercial demands. At low tide the city of Panama is surrounded by mud flats; there is no deep water anywhere near the shore; ships anchor in the bay three or four miles away, and cargoes are brought to the wharves by lighters during high water.

At Panama the actual width of the isthmus from tide water to tide water is only 35 miles in a straight line. The continental divide is about eight miles from the Pacific, and in places less than 300 feet above mean tide. Between this low mountain ridge and the Atlantic lies a hilly country intersected by streams the drainage of which is into the Atlantic through the Chagres River. The Chagres rises in the mountains about 45 miles east of Colon, and enters the Caribbean Sea some miles west of the Atlantic terminus of the canal. The valley of the Chagres, with the low country adjacent to it, forms a natural approach from the Atlantic side. To pass from this valley to the Pacific, it is necessary to go boldly across the low ridge of the Cordilleras. The route selected by the original French company for the Panama Canal is, in a general way, the same as that on which the Panama Railroad was built 30 years before; subject to variations of detail, the routes are practically one, and the only possible route in this part of the isthmus.

The Chagres is a tropical mountain stream, with the excessive variations of discharge which belong to such a river; its maximum flood discharge is approximately 300 times its minimum dry season discharge, which does not differ materially from the extreme range of many rivers in the United States. The area of its total drainage basin, though not completely surveyed, is about 1,200 square miles. It has a comparatively rapid fall, which is greatest near the source; at the point where the canal leaves the Chagres valley to cross the divide the bottom of the Chagres River is about 40 feet above mean tide. The principal difficulties of the northern portion of the canal, from Colon to Obispo, lie in the control of the Chagres River; the principal difficulty of the remainder is the summit cut. In a tide-level canal, such as the original French company proposed to build, these difficulties were virtually all. With the abandonment of the tide-level scheme and the adoption of a summit level reached by locks the problem of water supply for this summit level was added; but as the only source of gravity supply for such summit level is the Chagres River, the problems of the control of this river and of the use of its water to feed the canal become virtually one.

The summit of the divide in the Culebra Cut is less than 9 miles from Panama Bay and only about 12 miles from the six-fathom contour at mean tide in the waters of the Pacific, while it is 35 miles from Colon harbor; although to reach the six-fathom contour a channel must be excavated a mile further. As the summit of the divide marks the limits of the drainage basins, it may be said that three-quarters of the length of the canal is in the valley of the Chagres. This is not strictly true, as Colon itself is outside of the Chagres watershed; but the fringe of country along the ocean is always outside of the watershed of a river, and this is a matter of little real importance. It may be briefly stated that for two-thirds of its length the Panama Canal must follow the lower level of the valley of the Chagres, and that for three-quarters of its length it is within the drainage of the Chagres. The study of the Chagres River is, therefore, the first essential, if one would comprehend the conditions which the builders of the canal must meet.

After leaving the low valley of the Chagres, the canal passes, for eight miles, through a heavy summit cut, commonly known as the Culebra Cut. This cut exceeds in magnitude any excavation ever yet made, although the abnormally heavy work is confined to a single mile. This is the second great problem of the canal.

The failure to appreciate these two conditions in the early days of its work on the canal was one of the causes of the failure of the Lesseps scheme. A proper plan for the control of the Chagres should have been worked out before any large amount of work was done in the valley of the Chagres, and the execution of the work should have been on lines which would have been determined by that plan. The work of excavation should at first have been concentrated on the great Culebra Cut, all the energies of the company being from the start devoted to the expedition of this part of the work, which would necessarily consume a maximum length of time. With such a plan the comparatively easy work in the low country should have been postponed until it was known what would be done with the Chagres and until the time for the completion of the heavy summit work could be measured. Various schemes were proposed for keeping the floods of the Chagres out of the canal, including, among other things, an enormous dam and a tunnel by which the waters would be allowed to escape towards the Pacific without overflowing the dam. These were little more than visionary schemes, which actual conditions proved impossible. Beyond the construction of some parallel diversion channels in the valley of the Chagres, which channels were generally of inadequate size, the original French company did absolutely nothing towards the solu-

tion of the Chagres problem, and comparatively little excavation in the Culebra Cut.

The New Panama Canal Company has done a great deal to determine the real facts about the Chagres River, and has elaborated more than one plan for the control and utilization of that river. It has done no actual work in this way on the ground. It has done work in the Culebra Cut, where it has concentrated its efforts with a view to getting as deep an excavation as possible and showing the character of the material which that cut penetrates. This excavation has all been done with the machinery provided originally by the old company; it has been done in the form of a narrow cut on one side of the great cut, the form of excavation being what they called a cunette, and which leaves the cut in good shape for further work. While the machinery used for this work would not meet the general approval of American contractors, and while many things have been done under difficulties and at greater cost than would otherwise have been necessary, the actual work done in the Culebra Cut by the New Panama Canal Company has really been the most intelligent construction work yet performed on the isthmus either at Panama or elsewhere.

Besides these two great problems, there are others of lesser difficulty, but equally essential to the completion of the work. Of these, however, comparatively little need be said here. The most important are the locks, the dimensions of which will be somewhat more than those of any lock ever yet built; but they involve no features sufficiently in advance of what has already been done to raise any novel problems.

Apart from the great engineering features mentioned, the real problems which require most study and skill are the control and sanitation of the isthmus. The former will require military organization with the discipline and power which render military occupation effective; the latter will require a thoroughly-trained corps, charged, first, with the duty of eradicating disease, and, second, with the duty of preserving healthy conditions when those have once been obtained. The former will require vigorous action and, perhaps, some violent measures; the latter will require the continual surveillance which often tests character more than the more emphatic earlier issues.

Control of the Chagres.

The Chagres is a tropical stream, subject to the extreme conditions which are found in this part of the world. The boundary of

its drainage basin has never been fully developed. The Isthmian Canal Commission, however, sent a party across from Mandinga harbor to the head waters of the Chagres, which followed the river down to Colon. This work virtually fixed the limit of the valley in one direction. Of the total drainage area of about 1,200 square miles 875 are above the Bohio dam.

The rainfall on this area averages, approximately, 100 inches yearly, which, although high, is not so excessive in the tropics as it would be in a colder climate, and barely half what it is at Nicaragua. The months of least rainfall are February and March, and this dry season sometimes extends well into either January or April, or both. The other eight months form a continuous rainy season, a rainfall exceeding eighteen inches having been observed in every one of these eight months; while rainfalls exceeding twenty inches have been observed in May, August, October, November, and December. During eight months of the year the problem is to dispose of the water of the Chagres; during the other four it is to make sure of enough water for the use of the canal.

The valley of the Chagres may be divided into four sections for purposes of description. The lower section is between its mouth and Bohio, Bohio being the place where it is proposed to build a dam to impound the river through the next section into a lake. The second section is from Bohio to Gamboa, Gamboa being the point where the canal and railroad both leave the Chagres proper to pass through or over the divide. The third section is from Gamboa to Alhajuela, which is the site where it has been proposed to build a second dam and to impound the upper river in a second lake. The fourth is the portion above Alhajuela, and is practically an uninhabited country.

The following table gives the areas of the watershed above the three governing points and the proportional areas and discharges of water.

	SQUARE MILES.	P. C.	PERCENTAGE OF DISCHARGE IN		
			DRY SEASON.	WET SEASON.	ANNUAL.
Alhajuela........	510	58	75	55	60
Gamboa..........	645	74	83	68	72
Bohio............	875	100	100	100	100

FIG. 2.

This is what occurs in normal conditions of the river as determined from the observations made by the New Panama Canal Company, the calculations being the special work of Gen. Henry L. Abbot, of the Engineer Corps of the United States Army, now retired, and who, as a member of the Comité Technique, was specially charged with this study.

Fifty-eight per cent. of the watershed of the Chagres, including only that above Bohio, is above Alhajuela. In the dry season seventy-five per cent. of the discharge comes from above Alhajuela. This shows that the conditions in the uninhabited mountain country above Alhajuela hold back the water during the wet season, to discharge it during the dry season, so that in the driest season the discharge of the river at Alhajuela is several times the amount of the rainfall above Alhajuela.

The upper Chagres, being that above Alhajuela, is practically a mountain stream; it runs between rocky banks, and is bounded by limestone cliffs. The water is clear, there is no alluvial deposit, and it is a beautiful mountain stream, which, apparently, has all the conditions to furnish a good water supply for the lower country and a good supply of water for the canal or any other purpose. The excellence of its water will probably be preserved while the country is inhabited only by those classes of animals which find their graves inside of other animals. Like all other rivers, it falls more rapidly near its source than below. The rapids are usually over rocks, but sometimes over boulders or very coarse gravel. Below Alhajuela there is more or less silt found in the banks of the river, and the conditions exist there which would make it in some measure a silt-bearing river. This has important significance in connection with the question of controlling the river.

Five great floods have been observed on this river.

DISCHARGE AT	1879		1885		1888		1890		1893	
	c. f.	p. c.	c. f.	p. c.	c. f.	p. c.	c. f.	p. c.	c. f.	p. c.
Gamboa...	78,600	61	64,500	86	58,100	75	65,400	93	43,100	85
Bohio.....	112,700	100	74,800	100	79,000	100	71,700	100	51,100	100

The greatest of these was that of 1879, which occurred immediately before the visit of M. Lesseps, with his party, to the isthmus. This flood was never measured; it has been calculated.

The three succeeding floods—in 1885, 1888, and 1890—which have been more carefully measured, did not differ very much, and

were generally somewhat less than three-quarters the discharge calculated for the flood of 1879 at Bohio. It is to be observed that the flood of 1890 was very large at Gamboa. This was to be expected. The conditions of the extraordinary flood of 1879 must have been very much the same as those which have produced the extraordinary floods on the Ohio River in the United States—a rainfall distributed over several tributaries in such order that the maximum discharge of each enters the main river when that river is already swollen by the maximum discharges of the tributaries above.

These floods are of exceedingly short duration. They come up quickly, and go down quickly. The maximum discharge lasts only a few minutes. The excessive flood is seldom more than two days, and probably never more than three. Taking the maximum discharge of the Chagres at Bohio at 112,700, the minimum discharge is only about 350—that is, the maximum discharge is 350 times the minimum discharge. Great as this may seem, it is not out of proportion to the floods which we have on many of our American rivers.

The maximum and minimum discharges of the Tallapoosa River in Alabama are not only in the same proportion, but of nearly the same amount as the Chagres. In the Susquehanna, below Harrisburg, a maximum discharge of 750,000 cubic feet per second occurred in 1889, at the same time with the flood on the Conemaugh which destroyed Johnstown. The minimum discharge is probably not over 2,000 feet per second.

In one respect, however, the Chagres differs materially from these American rivers. The Tallapoosa, with a drainage area of about 3,000 square miles, produces the same results which the Chagres gets from a drainage area of less than nine hundred. The flood discharge of the Chagres, taken at Bohio, in the flood of 1879, was 129 cubic feet per second for every square mile of watershed; which is tremendous. This flood, if continuing for twenty-four hours, would correspond to a run-off of four and three-quarter inches of rain, all running off at the same time. Great floods, derived from a limited watershed, have given the Chagres its reputation; it is a little river, of small drainage area, with the floods of a big river. This, however, does not increase the difficulties of control. If you have to provide for 100,000 cubic feet per second, it makes no difference whether it comes from a thousand square miles or ten thousand square miles. The methods of control are the same.

There are three methods of controlling floods. One is by storage reservoirs. We have already one of nature's reservoirs on the upper Chagres, in the forests, and the general character of the soil. Another is by separate diversion channels. The third is by making the channel of the river itself, or of the canal, adequate to carry them off. All of these methods have been suggested.

Three reservoir schemes have been proposed. One would be formed by a dam at Alhajuela, which is an excellent place to build a dam; with rock banks and bottom, a masonry dam could be built here which would impound an immense supply of water, and practically reduce the amount to be taken care of in the lower river to the discharge of the lower basin. Another scheme was to build a dam for the same purpose at Gamboa—which would have been an excellent scheme if conditions had admitted of building a dam; unfortunately, no bottom could be found. The third proposition was to build a dam at Bohio; the Bohio dam would make the great Bohio lake, which is the solution of the Panama Canal question.

Separate diversion channels are objectionable. The canal must generally be in the lowest part of the valley. If the valley is broad, diversion channels are practicable. At Panama they are practicable below Bohio; they are not practicable above.

The third method, making the main canal big enough to carry off the floods, would require a canal with a bottom width of 400 feet. Such a canal would have the advantage of a very liberal waterway during ordinary stages. It might become silted up a little during the floods, but this could be removed easily by modern dredges; and the value of the additional waterway would more than balance the dredging expense. The writer considers this the only feasible way of carrying off the flood discharge if a tide-level canal is built.

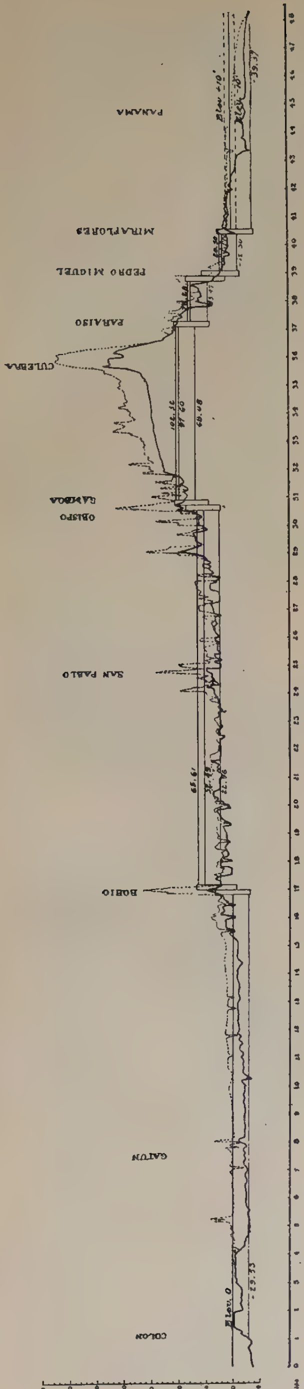
The tide-level canal with this broad channel was estimated on by the Isthmian Canal Commission. In the writer's judgment, it would be the best canal when built; but it would take at least ten years longer to build than the canal with a higher level, and that additional time is fatal to the scheme.

The tide-level canal being set aside, the alternative is a canal with a summit level reached by locks, in which the great depth of the Culebra Cut can be reduced, and some other method than a broad channel found for the control of the Chagres. Such a high-level canal was proposed by Commander Lull, U. S. N., as early as 1875; his plan proposed to keep the canal everywhere well above the level of the Chagres, crossing the river on an aqueduct near Gamboa. Another high-level scheme was proposed in the latter

days of the work of the Lesseps Company, although accepted by him only as a temporary measure. The New Panama Canal Company adopted a high-level scheme, in which a dam at Bohio converts the river above into a lake with the surface about 60 feet above tide water; from this lake the canal rises by two locks to a level 60 feet higher through the great Culebra Cut; this summit level is above the level of the Chagres, and was to be supplied with water through a complicated feeder from a second lake above the Alhajuela dam. After passing through the great cut, it descended, by a single lock at Paraiso, to a short level, thence by a flight of two locks at Pedro Miguel to a third level, and finally by a fourth lock at Miraflores to the level of the Pacific. While this plan was adopted by the New Panama Canal Company, it was manifest that the selection was based principally on the time required for construction, and that a plan, in which the level of Lake Bohio was carried through the Culebra Cut and the higher level with its complicated feeder avoided, would have been preferred if it could have been built in the same time. The plan adopted by the New Panama Canal Company required a flight of two locks at Bohio to ascend to the level of the lake, and a second flight of two locks at Obispo to ascend to the summit level, and four locks to descend from the summit level to the Pacific, of which two were grouped in a flight at Pedro Miguel, thus making eight locks in all.

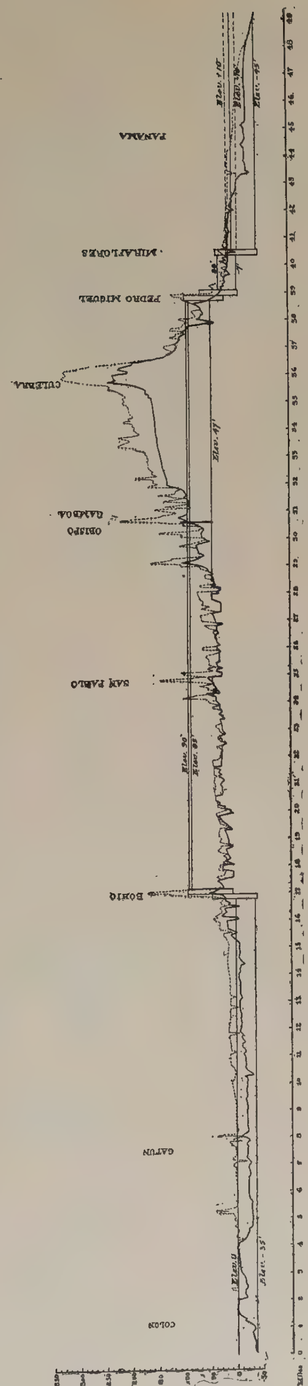
The Isthmian Canal Commission adopted a plan for a high-level canal differing from that of the New Panama Canal Company in that it raised the level of Lake Bohio from 60 to 85 feet above tide water, carried the level of the lake completely through the Culebra Cut, and dispensed with the second lake above the Alhajuela dam. By using a fixed spillway 2,000 feet long at the head of the Gigante valley, about four miles from the navigated course in the canal, the regulation of the lake was made entirely automatic and the discharge of the Chagres floods kept safely out of the line of the canal below Bohio. This plan requires a flight of two locks at Bohio to ascend to the lake, a flight of two locks descending at Pedro Miguel, and a single lock at Miraflores, making five locks in all.

The Commission's plan followed the same location as the French plan; but a modified route has been suggested, which will follow more closely the location of the Panama Railroad, shortening the distance by a mile and a quarter, on which route it would probably be expedient to use an intermediate level and place an additional lock at Tiger Hill.



NEW PANAMA CANAL COMPANY'S PLAN

FIG. 3.—PROFILE.



ISTHMIAN CANAL COMMISSION'S PLAN

FIG. 4.—PROFILE.

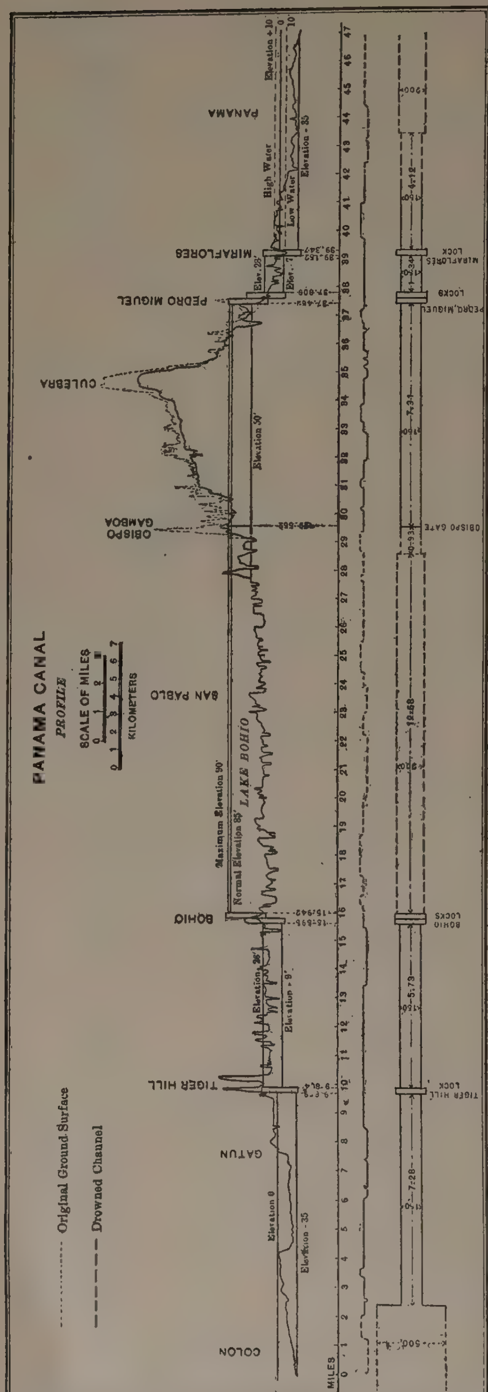


FIG. 5.—TIGER HILL LINE.

In either of the two last plans Lake Bohio is the method of controlling the floods. It has an area of 40 square miles. When a great flood comes down the river the lake will begin to rise slowly, and by the time it has risen five feet will have reached its maximum, and the discharge over the spillway, three or four miles from the navigated course, will be taken away beyond the lower level of the canal. The lake is of such size that no flood will ever create a current in it exceeding that in the Detroit River, which is perhaps the best example of a North American navigable river. During all ordinary conditions the lake will simply have enough current to keep the water in it sweet. The dam and spillway are as complete a solution of the much-decried problem of the control of the Chagres as has ever been found for any great hydraulic question.

The water for the canal must come from the Chagres River,

and during the low water season the supply is inadequate. About 1,000 cubic feet per second are required for the use of this canal, for evaporation and for other losses. The least discharge of the Chagres is about one-third of this; but this is a very rare occurrence. The entire deficiency between two seasons of high water has never exceeded 3,000,000,000 cubic feet, and this would be supplied by drawing down the level of the lake three feet. There are other methods of supply. One is the second lake above the Alhajuela dam. Another is the old Yankee device of flashboards, by which the lake could be maintained three feet above its normal level, the flashboards going out in extreme floods. In the writer's judgment, no provision should be made for low water until the canal is open for traffic. This would mean running the risk of having less than 35 feet of water in the summit level in extreme dry seasons. Flashboards could be used, if necessary, and if the deficiency was found troublesome, the Alhajuela dam could be built, after the canal was open to traffic, better than before.

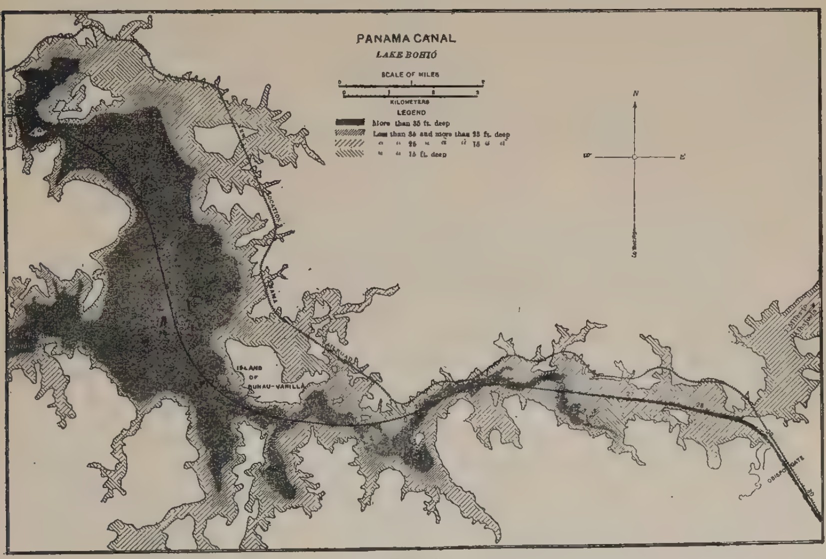


Fig. 6.

Lake Bohio is in itself an adjunct of great value. It is an interior harbor and an anchorage. It is absolutely land-locked, and the deep water runs into side valleys, where ships could be concealed. It will be a beautiful body of water, and in it will be an island of about 400 acres, which I have proposed to call the Island of Bunau-Varilla, in honor of the brilliant Frenchman who has

never despaired of the completion of the Panama Canal, and to whose untiring energy we owe much.

Culebra Cut.

The Culebra Cut, meaning thereby the whole summit cut, is 7.9 miles long, with a maximum depth of 280 feet, and, according to the plans of the Isthmian Canal Commission, would have a bottom width of 150 feet and a depth of 35 feet below low water. The material is an indurated clay, which has a stratified formation, but which is not rock, although nearly as expensive to excavate as soft

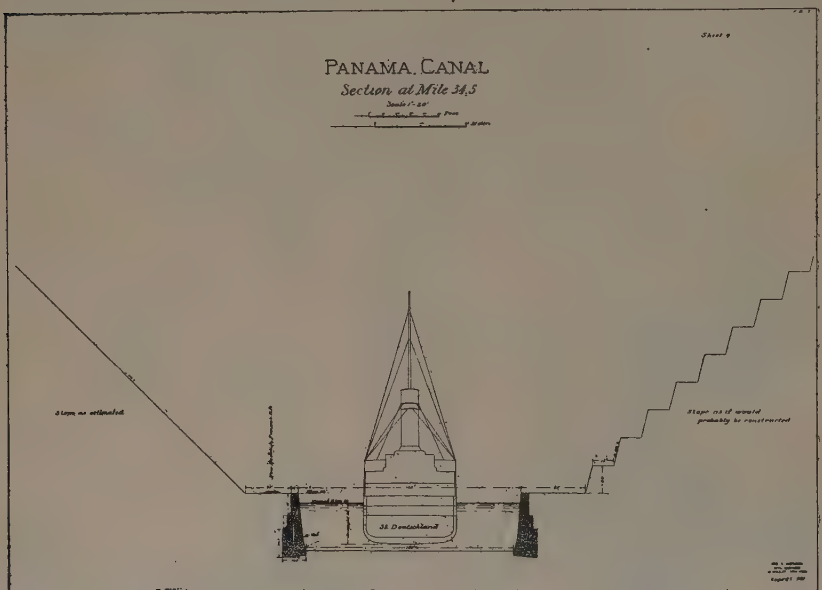


Fig. 7.

rock. There are in it some strata of hard rock and occasional dikes. It would have to be loosened by powder and given a flatter slope than rock usually requires. This cut will be the largest single excavation ever made. It will contain about 42,000,000 cubic yards of excavation. This sounds enormous, but it is only twelve times the volume of the great Pyramid; and if we of the twentieth century cannot handle twelve times as much earth or stone as the people who lived 6,000 years ago laid up in masonry, what are we to think of our modern civilization?

It is thought necessary to line both sides of the cut below water, and the best form of protection seems to be by two heavy masonry walls with nearly vertical faces, so that there will be no danger of

ships striking them, and which will afford benches above, on one of which the track of the Panama Railroad can be laid, and which will catch any material which may slide down from the slopes of the cutting before it reaches the canal. The sides would probably be taken out in a series of benches connected by comparatively steep slopes, but the estimate has been based on an equivalent slope of one on one.

The locks proposed would have a greater capacity than locks that have ever been built for any work. They are to have a clear length of 750 feet and a clear width of 84 feet, with 35 feet of water at all stages over the mitre sills. The plans provide for duplicate locks everywhere.

The Isthmian Canal Commission's estimate was $144,000,000 to complete the work from its present condition, besides $40,000,000 to be paid to the French Company, but including no interest during construction. Great as this amount is, it is much less than a canal of equal capacity can be built for on any other line across the isthmus. Furthermore, with some modifications, which perhaps could be made to advantage, and by deferring the duplication of locks till a later time, the canal could probably be opened for traffic at a cost of $150,000,000, including the payment to the French Company, although not including interest during construction.

Time of Transit.

The total distance from the shore end of the enlargement for Colon Harbor to the shore end of the wide channel through the mud flats in Panama Bay is 41 or 42 miles. This is divided into two canals by a lake more than 12 miles long in the middle; 13 or 14 miles of canal navigation, not including locks, lie between Colon Harbor and the Lake; a little more than 14 miles of canal navigation, not including locks, lie between Panama Bay and the lake. It is the navigation of these two canal sections which will regulate the passage across the isthmus. While the speed of steamers through the canal will vary with their size, the time which a ship of mean dimensions would take to pass through these two sections may be estimated as follows, the speed in the canal being taken at five miles per hour:

Colon Harbor to Tiger Hill lock, 7.28 miles..........	1	hour	27	minutes
Tiger Hill lock.......			45	"
Tiger Hill lock to Bohio locks, 5.73 miles............	1	"	9	"
Bohio double locks..................................	1	"	15	"
	4	"	36	"

Panama Bay to Miraflores lock, 4.15 miles		50 minutes	
Miraflores lock		45	"
Miraflores lock to Pedro Miguel locks, 1.34 miles		16	"
Pedro Miguel double locks	1 hour	15	"
Pedro Miguel locks to Lake Bohio, 8.84 miles	1 "	46	"
	4 "	52	"

This time could be reduced for smaller vessels; it will be exceeded by the largest vessels. It may be said, in a general way, that the time required to pass from either ocean into the interior lake will not be less than four hours, and it should not exceed five hours, except for the very largest class of ships. To these figures should be added the time required to pass through the lake and the time lost in Colon Harbor or Panama Bay. It would, perhaps, be fair to add half an hour for each of these terminals, and an hour and a half for the passage of the lake; this would make the total time required for the passage of the canal from 10.5 to 12.5 hours.

Many steamers would take coal at Colon, and all would have to stop at the entrance port to pay tolls, take pilots, etc. There would be abundant room to tie up vessels in the broad harbor section at the Colon end. There is abundant anchorage in Panama Bay, the distance from the canal entrance to this anchorage being determined by the size of the ship and other considerations. There is ample room for ships to anchor and lie up in Lake Bohio, where they could get fresh water and, if necessary, make slight repairs. It is not probable that either section of canal would be traversed at night, except by the smallest class of vessels and in emergencies. Ships would probably prefer to enter the canal from either end about daylight or soon after noon. Ships entering in the morning would make a daylight passage, meeting in Lake Bohio. Ships entering after noon would spend the night in Lake Bohio and pass out on the following morning, probably proceeding under dispatch orders and meeting the in-bound ships at the locks. The Tiger Hill lock, if used, will be approximately half-way between Colon and Lake Bohio, and the Pedro Miguel locks are approached in about the same length of time from the lake and from Panama Bay.

Conduct of Work.

The Isthmus of Panama has had a bad name for centuries. The climate is not a healthy one. It has been a transit line since the early Spanish occupation, and is inhabited by a mixed population of the lowest type. No systematic sanitary work has ever been undertaken. There is an abundance of excellent water in the


PANAMA CANAL
GENERAL MAP
SCALE OF MILES
KILOMETERS
PACIFIC OCEAN
Bay of Panama
PANAMA
MIRAFLORES
PEDRO MIGUEL
LOCK
Rio Grande
CULEBRA
GAMBOA
OBISPO
ALHAJUELA
RAILROAD
SAN PABLO
LAKE BOHIO
BOHIO
LOCKS
TIGER HILL
Rio Gatun
GATUN
LOCK
Diversion
COLON
Bay of Limon
FORT LORENZO
CHAGRES
Rio Chagres
CARIBBEAN SEA

Fig. 8.

mountain streams, but no village or city has a water supply. There is no sewerage. The women wash the soiled clothes in the streams and the people get their water from the same streams. Nearly every vile disease may be found there, and the filth of centuries is kept under some of the houses. It is a tropical country living under the same sanitary conditions which fostered the plague in temperate Europe during the Middle Ages. The death-rate is higher in the dry season than in the wet season, which tells the story of the contamination of the water. The first thing to do is to clean the isthmus, to provide sewers where feasible and sanitary rules everywhere, to furnish the entire line with good drinking water, of which a great abundance may be had at moderate expense, and to compel the employees on the canal to drink nothing else. This will take at least a year.

The plans made by the New Panama Canal Company were unusually complete for preliminary work of this kind; but they were for a canal of different dimensions, with many details which would not be acceptable to American builders. The plans and examination of the Isthmian Canal Commission were made for purposes of estimate and for preliminary work rather than for actual construction. The final working designs remain to be made. Specifications must be prepared, and all the necessary preliminaries which precede the letting of contracts for so great a work must be completed. Both the home and local organizations must be perfected. Much of this work can be done simultaneously with the sanitary preparations, and will take as long. A year spent in preparation before the contracts are let will save time in the end.

After the contracts are awarded the contractors should be allowed another year to perfect their preparations. This is little enough time to provide for the organization of their forces and the purchase and collection of their machinery, much of which will have to be built after the contracts are awarded.

In two years after the transfer of the French property, and the beginning of American occupation, actual construction work should fairly begin. The one greatest single piece of work is the Culebra Cut, and the time required to complete this cut will be the time which it will take to build the canal. All other work should be laid out with reference to this, so that when it is completed there will be no unfinished work to delay the opening of the canal.

The bulk of the laborers must be West Indian negroes, from Jamaica and, perhaps, some other islands. Skilled labor must come from the north, and generally be white. The methods of

work should be so designed that the number of skilled workmen shall be as small as possible, and that they shall be protected from rain and sun when at work. It will probably be expedient to use electric power instead of steam as far as possible. A dam at the site of the Alhajuela dam would furnish the power. If electrical shovels could be used instead of steam shovels, but one skilled man instead of two would be required at each shovel, and the heat from the boiler would be avoided. Although active disease may be exterminated, the debilitating influences of the damp, warm climate will remain, and a system of furloughs must be arranged which will permit the white employees to recuperate in northern climates about once a year.

The French companies were private corporations, working with no greater powers than those derived from their concessions. All this will be changed when the work becomes a Government undertaking. The powers of the United States will be those of military occupation, under which sanitary control and discipline can be exercised, which should remove the greatest difficulties which have hitherto beset the Isthmus of Panama. When the work is completed the malarial spots in the interior will have been replaced by Lake Bohio, and the condition of the isthmus should be no worse than that of other damp tropical countries. Lake Bohio, surrounded by hills and mountains, will be a beautiful and accessible body of water, traversed by frequent steamers, with all convenient connections with the ports of other countries. The surrounding hills will add beauty to the landscape and furnish sites for gardens and residences. It is not impossible that this region, which has been regarded as one of the world's pestholes, will in time become a favorite winter resort.

NEW YORK, December 23, 1902.

CO-OPERATIVE TOPOGRAPHIC SURVEY OF NEW YORK.

Excellent progress was made during the past summer in extending the topographic survey of New York State. The appropriation by the Legislature for this purpose was $20,000, and the Federal Bureau devoted a like sum to the work, and had immediate charge of it in connection with the general topographic survey of the United States.

During the season just closed mapping was completed of 3,090 square miles, which will be published in fifteen atlas sheets. In addition, primary triangulation for control of future areas was extended over 2,310 square miles. In the course of the topographic mapping careful spirit levels were run for the control of the area surveyed, which aggregated 2,566 linear miles. Dependent on this there were established 103 permanent bench-marks, chiefly bronze or aluminum tablets cemented into masonry structures, and in addition 2,500 temporary bench-marks were established, while the elevations of 8,496 positions were determined. Furthermore, in the course of the mapping 9,006 linear miles of roads were carefully traversed, and their routes exactly indicated upon the maps.

The names of the sheets completely mapped during the past season are derived from the most important villages or cities within their limits, and are as follows, namely:

In the Adirondacks: Long Lake, Saranac Lake, Boonville, and Carthage. *In the Catskills:* Hobart and Richmondville. *East of the Hudson:* Copake. *In central New York:* Batavia, Caledonia, Wayland, Coventry, and Greene. *In western New York:* Chautauqua. *On Long Island:* Setauket and Fire Island sheets.

The drafting of these is well under way, and preliminary photolithographic copies of all will soon be available for distribution in a limited number to such persons as may have immediate use for them.

During the past year the engraving division of the United States Geological Survey has published the following New York sheets: Clyde, Weedsport, Geneva, Genoa, Ovid, Palmyra, Phelps, Sodus Bay, Pultneyville, Clayton, Grindstone, Morrisville, Millbrook, Schunemunk, Newburg, Broadalbin, and Saratoga.

The total result of the topographic surveying to date has been the complete and final mapping of 31,106 square miles, or 64 per cent. of the area of the State, which is 49,170 square miles. Pri-

mary triangulation has been extended over unmapped areas aggregating 12,770 square miles. The result of this great survey of the State will be published in an immense topographic map consisting of 264 separate atlas sheets of uniform size. Of these, 132 have been issued, and 44 others are in course of publication.

The drafting on the Boonville sheet of the topographic survey of New York has just been completed, and it represents some unusual topographic features. This sheet depicts the topography of an area of 220 square miles on the western slope of the Adirondacks, in the depression separating them from the elevated plateau land which lies further west and to the north of Rome. The most striking feature of this region is the large number of terraces and broad benchlands which occur at various elevations on either side of the valley of the upper Mohawk River. Their relation to the surrounding country is best stated in connection with an examination of the Carthage sheet, also completed during the past season, and situated northwest of the Boonville sheet and in similar relation to the Adirondacks and the highland to the west thereof. On the former sheet these terraces are best brought out along the valley of the upper Black River.

On the Boonville sheet the lowest notable bench has an elevation of 565 feet, and 60 feet above the broad, alluvial valley which extends from Delta to Northwestern, about 60 miles. This valley will interest engineers who are studying water storage in the State, as it offers possibilities of striking a great storage reservoir and the building of a dam in the narrows two miles below Delta. Such a dam, if erected to the height of 60 feet, would flood an area covering nearly four square miles.

The next terrace is most pronounced immediately west of Delta, with a uniform elevation of 600 feet. Near Westernville are marked terraces with altitudes of 620 and 640 feet. Near Northwestern are a group of terraces and pronounced benches, on the slopes of the hillside, having elevations of 660, 700, 760, 800, 840, and 900 feet. The upland, called to the south of the West Branch of the Mohawk River "Quaker Hill" and to the north thereof "Webster Hill," is comparatively flat-topped, or table-topped. The southernmost table-land has a general summit altitude of 1,280 feet, and the northernmost table-land a general elevation of 1,580 feet.

From the above brief description it is evident that the whole country has been tilted, with the higher elevation toward the north, because corresponding terraces found near the southern portion of the area, and formed probably at the same time, are at much lower

altitudes than the same terraces to the north. All these benches and table-lands tilt with an inclination of about 300 feet in six miles, and these facts will give some interesting food for thought and discussion when the map is critically examined by geologists.

On the eastern portion of this area, that which drains from the Adirondacks toward Mohawk River, the most interesting topographic feature is the manner in which certain brooks have eroded wide channels of uniform slope as they approach with steep descent the valley of the Mohawk. Immediately east of Delta are two streams unnamed which, commencing at an elevation of 900 feet, have eroded channels an eighth of a mile wide, with perfectly smooth, uniform slope to an elevation of 600 feet, after which they pursue their course with varying grades to the Mohawk River. The margins of these wide stream valleys have very steep, bluff slopes, cut with almost knife-like edges straight down to the flat bottom-land. Better examples, even, of this peculiar form of erosion are to be found on the headwaters of Big Brook, above Branchville, and immediately north of Northwestern on Stringer Brook.

A critical examination of the Carthage sheet, drafting on which is still in progress in the office of the United States Geological Survey, gives an idea of the very interesting topographic feature which will be developed in the highland southwest of Carthage and north of Rome when it has been completely mapped. This is a little-known region, and one of which the general maps give an inaccurate conception. Topographically, this region differs radically from the Adirondack country and from the great upland of southern central New York. It is a high, elevated plateau region, covered in large part with a dense growth of timber and largely submerged in swamp. Much of this area was lumbered over in the early days, and is now grown up with second growth, and it is exceedingly inaccessible, the old log roads being tangled with underbrush. The streams of this area abound in trout, and the topographers found the best trout fishing and deer hunting in the State in this area. The northern slopes of this upland, which are shown on the Carthage sheet, have accentuated upon them the terrace and table-land features which were prominently outlined in the upper Mohawk valley near Boonville. The drainage on the Carthage area is northward and eastward toward Black River. The valley of the latter in the neighbourhood of Carthage is broad and level. At Carthage, above the falls, the altitude is 730 feet. This same elevation is maintained for six miles to above the junction of Beaver River. From the map it would appear that a great dam might be built across

the Black River just above the falls below Carthage, with a height of about 50 feet, which would store water over an area of probably twenty square miles, backing the water up to within a few miles of Lowville. Above the Carthage bottom-land and to the southwest thereof up the slope of the highland, the first marked terrace has a height of 812 feet, and is over a mile in width. Immediately above it is a second terrace, with an altitude of 920 feet and about one-half mile in width. Two miles further back is a pronounced terrace, with an altitude of 1,220 feet, which is over two to four miles in width. This terrace holds this uniform altitude for a distance of over twenty miles northwest and southeast. The next high terrace is less pronounced, its summit being more highly eroded, and its altitude about 1,450 feet.

Above this the country slopes with almost uniform rise for six or eight miles to the summit of the upper-land, which has a comparatively uniform elevation of nearly 2,000 feet. An interesting feature of the terraces on the north slope of this highland is that they have a nearly uniform elevation throughout their extent, showing that there has been little inclination in an east and west direction since their formation, the whole inclination having been toward the southwest, as developed in connection with an examination of the Boonville area. H. M. W.

THE CATTLE INDUSTRY IN THE UNITED STATES.

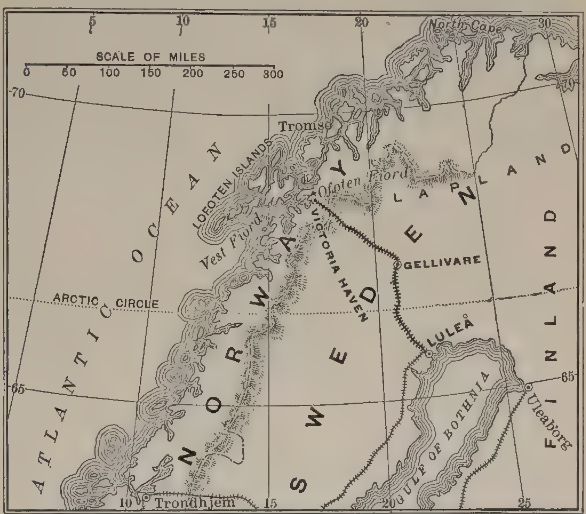
The rise in the price of beef during the autumn of 1901 turned public attention in the United States in a rather sudden way towards the beef cattle industry. Questions began to be asked regarding the future price of beef, and this brought up the whole problem of the numbers of cattle in the United States, the availability of pasture lands, and the relation of supply and demand in the beef market. The so-called "Beef Trust" received a large share of the blame for raising prices, which in reality were partly due to the drought of the summer of 1901, the resulting heavy shipments of cattle to market, and the high price of corn as fodder in the months that followed. One of the clearest and best expositions of the present state of affairs as regards "The American Ox and his Pasture" is found in the *Review of Reviews* (New York) for January,

1903, and is by Chancellor E. Benjamin Andrews, of the University of Nebraska. The writer points out that "public pasture is dying out. Areas which half a century ago grew vast herds of buffalo, antelope, and deer, and, subsequently, even more immense troops of cattle, are now almost a waste." This has resulted from the reckless abuse of the range—the pasturing of too many cattle and sheep upon it. Many of the best grasses are annuals, and the reckless feeding of cattle on these leaves little seed for renewal. Thus some of the best grasses have ceased to exist where they were once abundant. During droughts the cattle pull up the grass by the roots. Near streams and springs the grass is trampled down and killed. Thus the cattle have to travel greater and greater distances from their pasture to water. When the grass becomes too poor for cattle, sheep are put in, and they kill the perennial grasses. Vegetable and animal scourges appear. Rabbits, prairie dogs, prickly pears, cactus, and other thorny bushes invade the land. Thus, in various ways it has come about that "extensive plateaus, once rich as gardens of the gods, are now in effect deserts." The cattle business is being forced on to higher-priced land, which makes beef more expensive. The present unfortunate condition of things can be remedied. With smaller herds, kept under supervision; with rotation in the use of pastures; with reseeding in places; by means of wells driven where cattle now have to travel far for water, and in other ways, vast tracts now unprofitable can again be turned into rich pasture lands. Climatic conditions determine, through deficiency of rainfall, that large portions of the United States shall always be better for grazing than for farming, although by means of irrigation, by intensive culture, and by careful selection of crops much of the semi-arid region can be turned into farming country, irrespective of rainfall.

R. DeC. W.

THE MOST NORTHERN RAILROAD.

This sketch map shows the route of the Ofoten railroad, opened for through traffic in November last between Luleä, on the Gulf of Bothnia, and Victoria Haven, at the head of Ofoten Fiord, on the Atlantic Ocean. The road penetrates about 100 miles north of the Arctic Circle, and is the most northern railroad in the world. Its total length is about 250 miles. The eastern part, between Luleä and the famous iron mines at Gellivare, 44 miles north of the Arctic Circle, has been in operation for over fifteen years. It has now been extended to the Atlantic, to facilitate shipments of iron ore. Luleä, on a narrow arm of the Baltic, is closed by ice for seven to eight months every year. At Victoria Haven, however, there is not only deep water for the largest vessels, but, like all the Atlantic ports of Norway, it is ice-free the year around, so that ore may be forwarded in every month to the blast furnaces of England and Germany.



THE MOST NORTHERN RAILROAD.

The mines at Gellivare yielded 800,000 tons of ore in 1899, 1,000,000 tons in 1900, and the quantity is expected to be largely augmented, now that there are better facilities for getting the mineral out of the country. These Swedish ores are regarded as among the best steel ores in the world; but they are difficult to reduce on account of the phosphorus in them, and, as Sweden has no coal with which to smelt them, she sells most of the ore to England and Germany.

Mr. L. de Launay, in his paper on Lapland (*Le Tour du Monde*, 1902, Nos. 45, 46), says that 1,800 miners and their families dwell

around the mines of Gellivare; and that further northwest, at Kirunavaara, on the line of the railroad, is a ridge 700 feet in height and several miles long of solid magnetic iron ore, which is estimated to contain over 200,000,000 tons of ore. It is expected soon to begin the development of this source of wealth.

The cost of building the railroad was borne by Sweden and Norway. The engineering difficulties among the mountains in Norway were considerable. The mountains are crossed through the rugged North Valley, in which twenty tunnels, aggregating over two and a half miles, were excavated and several bridges were built, the largest being 591 feet in length and 120 feet above the valley at its highest point.

An ore dock, nearly 1,000 feet in length, and built after the best modern plans with large storage bins, is now being constructed at Victoria Haven. The road will give easy access to the Norbotten (North Bothnia) district of Sweden, which, besides its deposits of iron ore, has considerable agricultural resources that will be developed with the aid of these new transportation facilities.

GEOGRAPHICAL RECORD.

AMERICA.

Place Names in the United States.—Bulletin 197 of the United States Geological Survey is a compilation by Mr. Henry Gannett, giving the origin of about 10,000 place names in the United States. It is filled with interesting information as to the various sources from which we have derived our geographical names. We learn that Book Plateau, in Colorado, was so called on account of its shape; Bombay, in Franklin County, N. Y., was named by Mr. Hogan, an early settler, whose wife had lived in Bombay, India; counties in seven States, besides towns and lakes, were named after Daniel Boone; ten counties and towns were named Bolivar, in honour of the military hero of South America; Block Island, R. I., was named for Adrien Block, the Dutch discoverer; Binghamton, N.Y., was named after William Binghamton, of Philadelphia, a benefactor of the town; Golden Gate, Cal., was named by Col. Fremont before the discovery of gold in that region because of the brilliant effect of the setting sun on the cliffs and hills;

Newport News was named after Captain Christopher Newport and Captain Newce; Nyack is an Indian word meaning corner or point; Painted Post, a village of Steuben County, N. Y., was so named because of a painted post erected by Indians over the grave of their chief; Pawtucket is an Indian word meaning "at the little falls"; Quogue is an Indian word meaning clam; Tarrytown is a modification of its former name, Terwen* (Wheat Town), given on account of its large crops of that cereal; Yonkers was named for a manor house built by the Dutch, the word meaning "Young Lord"; Haverstraw, named by the early Dutch Haverstroo, means oats straw. Of course, the *villes*, *boros*, and *burgs*, with the names of earlier settlers or prominent men, are very numerous. The *Bulletin* is a valuable addition to the nomenclature of the country—a subject not to be treated with authority.

Paleontologic and Stratographic Map of the Canandaigua Lake Region.—Dr. John M. Clarke, New York State paleontologist, describes (New York State Museum *Bulletin*, No. 52) an effort to portray on maps, with exactitude and fullness, the paleontologic facts, or, in other words, the actual succession of vital events in the earth's history. He selected the Canandaigua Lake region, which has been studied, perhaps, with more care with reference to the succession of its fossil faunæ than any other equal area in the State. The so-called "geologic maps" of to-day do not attempt to represent anything further than the succession of sediments, or lithologic units. Such a map cannot tell the whole truth, for faunas do not vary *pari passu* with sediments. Thus the vital and organic element of the history of the earth is eliminated from these maps. Dr. Clarke has prepared a map of the two quadrangles known as the Canandaigua and Naples sheets, which afford a rock succession of a vertical thickness of about 3,000 feet, on which he has shown the succession and variation of faunas, or what may be termed a true paleontologic map. It is proposed to issue these maps as companion sheets to the geologic map, and to illustrate by means of them the actual relation of the more important variations in faunas to variations in sedimentation.

Topographic Forms in the Catskills.—The details of the topographic forms in the western portion of the Catskills are admirably illustrated on the map of the Hobart quadrangle, surveyed during the past season. The area covered by this extends for about

* Properly *Tarw*, or *Tarwe*.

eight miles in each direction from Stamford as a centre. Immediately south and east of Stamford the country rises rapidly as a massive upland, sloping quite uniformly to the highest summits, of which Mt. Utsyantha is one of the higher peaks in the Catskills, with an altitude of 3,213 feet. Mt. McGregor, about two miles southeast, has an elevation of 3,253 feet. From the former a fine view is had of all of the surrounding country, as it is quite accessible by good wagon road to the observation tower on the summit. A characteristic of this region is the uniformity of slopes produced by long erosion on rocks of the same formation, the drainage lines being deep sunk in the narrow valleys. The margins of these valleys show numerous little hillocks and benches outlining stream deposits, which occurred when the valley bottoms had higher altitudes than those of the present time. The underlying formations appear to have a general inclination to the southward, as the erosion on the northern slopes of all the valleys has produced much steeper gradients on that side than on the southern.

Another of the high peaks of the Catskills is Blackhead, the altitude of which is 3,937 feet, as shown on the Durham sheet, an old issue of the Geological Survey. Still higher is Hunter Mountain, immediately south of the former, and about ten miles west of Kaaterskill Mountain House, the elevation of this peak being 4,025 feet. Slide Mountain, which is a few miles southwest of Phœnicia, is now definitely proved to be the highest peak in this region, its elevation being 4,204 feet.

H. M. W.

Topographic Surveys in Western New York.—An interesting region topographically is that mapped during the past season immediately to the south and west of Rochester, in the neighbourhood of Honeoye Falls, Wayland, Dansville, Geneseo, and Caledonia. This country is on the northern slope of the great central upland, and contains some of the most interesting of the typical smaller Finger Lakes of central New York. The lowland towards Rochester Junction is filled with small hillocks, the morainal deposits from the great glacier which at one time covered the greater portion of New York State. These hillocks are nearly all oval in form, the major axis lying in this neighbourhood almost exactly north and south, thus showing the direction of the movement of the glacier, and having elevations of from 50 to 150 feet above the general elevation of the surrounding country. The positions of old glacial rivers are well outlined, especially immediately

to the north of Honeoye, where Honeoye creek now parallels the Lehigh Valley Railroad, the former course of this stream having been about two miles to the south of its present valley. Another old glacial river is well outlined along the line of the Lehigh Valley Railroad immediately east of Caledonia. To the southward of this low morainal area the country rises rapidly, but with comparatively uniform slope, from an altitude of 660 feet at Honeoye Falls to 2,000 feet on the higher divides separating Hemlock and Conesus Lakes. The highest of all these Finger Lakes is probably Canadice, which has an altitude of 1,092 feet, Hemlock Lake being second with an elevation of 896 feet. Both these lakes, but particularly the latter, are deep sunk in narrow valleys excavated by glacial action, and are bordered by very high ridges, which rise with unusual precipitateness from their margins. Thus less than a mile to the east of the shore of Hemlock Lake is Bald Hill, the summit of which has an elevation of 1,840 feet. At three-fourths of a mile west of Hemlock Lake is the summit of Marrowback Hill, the altitude of which is 1,925 feet. The rise is over 1,000 feet in considerably less than a mile, and these slopes are highly eroded by the numerous steep gulleys which serve as watercourses for the rain which falls on the abrupt hillsides.

H. M. W.

THE LEVEL OF GREAT SALT LAKE.—Mr. L. H. Murdoch, Section Director of the United States Weather Bureau at Salt Lake City, has lately been giving considerable attention to the problem of the level of Great Salt Lake (*Monthly Weather Review*, XXIX, 1901, 22–23 ; XXX, 1902, 482–485). In the *National Geographic Magazine* for February, Mr. Murdoch points out that the reading of the gauge on Dec. 1, 1902, was 3 ft. 5 in. below the zero of the scale, showing a fall of 11 ft. 7 in. since the close of 1886, the year in which the last rise terminated, and a level between 3 and 4 feet below that of 1847. A wet cycle prevailed at Salt Lake City from 1865 to 1886 ; while from 1887 to 1902 a dry cycle has prevailed, the average precipitation during the latter period being 1.85 in. below normal. Since 1887 there has been a steady decline in the level. While the amount of water used for irrigation has been increasing, Mr. Murdoch does not believe that irrigation can be charged with more than 3 or 4 feet of the last decline of the lake level, and that while the length of the dry period from 1827 to 1864 was 37 years, he does not think that these recurring periods are of equal length. "A wet cycle like that which began in 1865 may begin next year,

or it may not begin for fifty or more years." The cycles which Mr. Murdoch finds in the Great Salt Lake region seem, on the whole, to fall in with the 35-year period of Brückner.

R. De C. W.

Collections for the National Museum.—The Smithsonian Institution is endeavouring to obtain for the National Museum exhibits illustrating the anthropology of the islands recently brought under the jurisdiction of the United States. Comprehensive suggestions as to the collection of such materials have, therefore, been printed as Part Q of *Bulletin* 39 of the National Museum. Army, navy, and civil officials in the islands are the agents through whom it is believed the larger part of the additions to our anthropological treasures will for the present be made.

EUROPE.

The Pyrenees and the Distribution of Animals.—Dr. R. F. Scharff, of Dublin, read at the Berlin meeting of the International Congress of Geologists, in 1901, a paper on the influence of the Pyrenees on animal distribution, which has recently been published. He pointed out that ranges running east and west, like the Pyrenees, have a greater influence on animal distribution than others, because they stand in the way of northward or southward movement resulting from climatic changes. The identical species on the two sides of the range may either have taken a circuitous route round its ends or crossed the crest when it was lower or had a still milder climate than at present. He believes that animals, like the chamois, crossed the Pyrenees from the east and spread over the Cantabrian Mountains within comparatively recent times. It is, of course, not surprising that the mountains proved no barrier to such animals ; but it is otherwise with reptiles and still lower groups. Many western forms of these crossed into France, no doubt by the lower hills at the extremities of the chain ; while eastern forms also made their way into Spain. The movements of amphibia are subject to many difficulties. Among the salamanders *Molge marmorata* and *M. palmata* seem to have been limited within comparatively recent times to Spain and France respectively ; but each has now crossed the range, though in small numbers, and seems to have utilized the lower western spurs as a point of crossing. An older form (*Salamandra maculosa*) evidently crossed the crest of the range, and is found at an elevation of 5,900 feet. Dr. Scharff arrives at the conclusion that, though causing some hin-

drance to animal migration, the Pyrenees may easily be turned at their extremities, and that the older forms have, as a rule, crossed the crest of the range, probably in some cases before the glacial epoch. (*The Geog. Jour.*, Feb., 1903.)

KITE METEOROLOGY OF THE WEST COAST OF SCOTLAND.—During the summer of 1902 Mr. W. H. Dines carried out an investigation of the meteorological conditions of the free air off the west coast of Scotland. Kites were flown every day, excepting Sundays, from the deck of a small steam tug, between July 8 and August 26. No difficulty was experienced in starting, flying, or recovering the kites during any weather. The average height reached was 4,000 ft. It was found, among the results of the work (*Quart. Jour. Roy. Met. Soc.*, XXVIII, 300–301), that the temperature gradient over the sea was considerably less than the average value over the land; that the Ben Nevis temperature was lower than that of the air at the same level some sixty miles to the southwestward, and that, as a rule, the humidity increased up to a level of about a mile, and then decreased. This work is interesting to Americans because the suggestion of flying kites for meteorological purposes from the deck of moving vessels came from Mr. A. Lawrence Rotch, of Blue Hill Observatory.

R. DE C. W.

CLIMATIC CONDITIONS FAVOURABLE TO HEATHER.—According to Dr. Paul Graebner, who has made a special study of the moorland heaths of northwestern Germany ("Die Vegetation der Erde," edited by Engler and Drude; Vol. V, "Die Heide Norddeutschlands," by Dr. Paul Graebner), the "Heide" area is distinguished from the Steppe region farther east by a moister climate, without long droughts; cooler summers, and less intensely cold winters. In Great Britain, wherever heather and its associates are dominant, similar conditions prevail. The amount of rainfall or of aqueous vapour is considerable and constant; long periods of drought occur rarely; the mean temperature of summer is low; the winter is variable, and ice-bound conditions do not last long.

Although the climatic control of heather is thus emphatic, it does not follow that, given the above conditions, heather must grow. Soil plays a very important part, heather being found characteristically on soils poor in plant food ("The Origin and Development of Heather Moorland," by Dr. W. G. Smith, *Scottish Geographical Magazine*, pp. 587–97, Nov., 1902).

R. DE C. W.

The Kaiser Wilhelm Canal.—While the traffic on the Kaiser Wilhelm Canal is not making rapid development, it is holding its own and slowly increasing. The report on the canal, just issued by the German Government, gives the statistics for the year ending March 31, 1902. The number of vessels of all kinds using the canal increased from 29,045 to 30,161. The tonnage increased from 4,282,094 tons in the previous year to 4,285,301. There was an increased tonnage in Danish, Dutch, and Russian vessels, but a decrease of tonnage in British, German, French, Belgian, Norwegian, and Swedish vessels. Both the receipts and the expenses of the tunnel slightly decreased, the receipts amounting to $530,755 and the expenses to $605,705.

AFRICA.

Geographical Surveys in Madagascar.—General Gallieni has an article in *La Géographie* (Vol. VI, No. 5) on the geographical surveys of the island since the French occupancy in 1895, with a chart showing the extent of the triangulations carried on between that year and 1901. All the resources of modern scientific geography have been utilized to produce a good map of the island, nine-tenths of which was still unknown previous to the French occupation. Practically the whole of the island has been surveyed, with the exception of a few small forest areas in the northeast and some thorny deserts in the extreme south. The map, based upon these surveys, supplies a great need of the civil and military administration, which had been much embarrassed by lack of good map material. Only the central plateau had been well mapped. The Jesuit Fathers, among the Hovas, had made numerous astronomical and geodetic observations, which supplied the basis for exact and valuable maps of that region. The maps of other parts of the island, based largely upon native reports, were found by the French to be very erroneous.

Railroad in German Southwest Africa.—The narrow gauge railroad between Swakopmund and Windhoek, in German Southwest Africa, has been completed. It is 237 miles in length and connects the capital and chief settlement of the colony with the sea coast. The region of mountains and deep valleys, among which Windhoek is situated, is well adapted for agriculture and cattle-raising where irrigation is possible. This is apparently the most valuable part of the colony, and is the district to which the Germans are inviting immigration. The railroad is expected, there-

fore, to be very important in the development of the country. As the region traversed ranges in altitude from sea-level to 5,000 feet, some of the grades are steep, and the passage of the valleys required bridges aggregating 4,600 feet in length. Passenger trains make the journey in two days, spending the night midway at Karibib; freight trains are as yet three to four days on the road.

ACCLIMATIZATION OF THE ENGLISH IN THE UGANDA PROTECTORATE.—In Sir Harry Johnston's book, "The Uganda Protectorate" (London, 1902), the author is very optimistic regarding the future of portions of that country as sanatoria for European colonists. The Nandi plateau, between 7,000 and 10,000 feet in altitude, is "without a single ugly or unfriendly spot. . . . It seems to be awaiting the advent of another race which should make it a wonderland of wealth and comfort, a little England, half a Scotland, or a large Wales, lying exactly under the equator, at an average altitude of 4,000 feet above the Victoria Nyanza." This rosy view of the future colonization of this plateau by British colonists, who shall make their permanent homes and bring up their families there, contradicts the experience of the English in India. In the opinion of a recent reviewer of Sir Harry Johnston's book," the critic who is familiar with the hill sanatoria of the Himalaya and Nilgiri mountains of India will not be convinced that Nandi is likely to be any better fitted for the permanent occupation of British capitalists and labourers, and their reproduction, than Darjeeling, Mussoorie, and Simla; Ootacamund, Coonor, and Kodaikanal."

R. DE C. W.

ASIA.

NAVIGATION ON THE YANGTSE RIVER.—The *Trade Reports* of China for 1901 contain some interesting facts with regard to navigation on the Yangtse. At Hankow, the great tea port on the river, 3,767 vessels, with a total tonnage of 2,678,246, entered and cleared during the year. Twenty-two river steamers run regularly between Hankow and Shanghai, and many ocean-going vessels also visit the port. Two German steamers run regularly between Hankow and Swatow, and eight tea steamships cleared for Odessa with cargoes of tea. Hankow is thus a river seaport, and is the furthest point inland in China to which ocean steamers penetrate. At Ichang, about 1,000 miles up the Yangtse, 348 steamers, with a total tonnage of 305,674, entered and cleared during the year. Many of these vessels are stern-wheel boats. As the number of

steamers increases the junk trade diminishes, though it is still very large. The rapids, which obstruct navigation on the upper Yangtse, begin some distance above Ichang. A few small steam vessels have succeeded in getting through these rapids to Chungking, the great commercial centre of Szechuan; but the general opinion now is that steamers can be practically useful in this stretch of the river only for towing boats between the rapids, and that improved machinery and a better organization of labour must be utilized to get freighters through the most difficult parts of the river.

POLAR.

Baron Toll's Expedition.—News of Baron Toll's party, received in Russia last fall, contained the surprising information that he was supposed to be on the little-known Bennett Island, north of the New Siberia group; also that his zoologist, Birula, was on New Siberia Island. Toll and the astronomer Seeberg left the winter quarters of their vessel, *Zaria*, on Kotelnoi Island in May last for Bennett Island. Birula and some natives had already started for New Siberia Island. The *Zaria* was instructed to visit these islands for the purpose of carrying the explorers back to camp as soon as the ice conditions permitted the vessel to go north. The *Zaria* left Kotelnoi early in July, but was unable to reach either Bennett or New Siberia Islands on account of the ice pack. Last fall the *Zaria*, with all the other members of the expedition, went south to the mainland, taking up winter quarters at the mouth of the Lena. Lieutenants Matissen and Koltchak, with nine men, returned to St. Petersburg in January, and reported that a relief party was to leave the *Zaria* by sledge for Kotelnoi, in the belief that the three explorers had probably made their way over the ice to that island. No special anxiety as to their fate is yet felt, as they had in view the possibility that the vessel might not reach them, and they might be compelled to winter on the islands which they intended to visit.

The Spitzbergen Degree Measurement.—In 1898 Swedish and Russian expeditions began operations for the measurement of an arc of the meridian, the Swedes occupying the more northern and the Russians the more southern parts of the Spitzbergen group. The work has been spread over five summers, in some of which little was accomplished owing to unfavourable weather conditions. It was completed last summer, when the Swedish expedition returned home after having effected a junction with the Russian net of triangles in the south.

THE GERMAN ANTARCTIC EXPEDITION.—The joint publication of the Berlin Institute for Oceanography and Geography, Part II, announces that the *Gauss* arrived at Kerguelen on January 2, 1902, where it met the land party that had previously reached the headquarters in Observatory Bay with supplies. On January 31 the *Gauss* sailed for her destination in the Antarctic with provisions for nearly three years. Dr. von Drygalski, leader of the expedition, intended, if possible, to land on Heard Island and then make straight for Wilkes's Termination Island, skirting the ice towards the west to take advantage of the prevailing easterly winds and ultimately turning southward and entering the ice. He thought it likely that the *Gauss* might lose some of her gear in the ice, and desired to caution friends at home not to infer that the expedition had met with disaster if pieces of wreckage from his vessel were picked up. He said he might be able to send news home by June, 1903; but, as the expedition is planned for three summers in the ice, no news will be good news till June, 1904.

AUSTRALASIA.

GLACIATION IN AUSTRALIA.—Mr. J. P. Thomson, in an address before the Royal Geographical Society of Australasia, Queensland, on September 22, 1902, said:

> To my mind, no satisfactory evidence of well-defined traces of glaciation in Australia has yet been brought forward. Drift ice masses may probably have left their imprints on some of the shore rocks of former estuarial channels, but there is nothing to indicate that the whole of the continent was at any time involved in extensive ice-sheets. In point of fact, the past and present fauna and flora denote the occurrence of mild climatic conditions which have prevailed for ages—conditions of climate partaking more of the tropical than the Arctic character.

Mr. Thomson adds, however, that after writing the above the newspapers reported that Mr. A. Gibb, Government Geologist for Western Australia, had reported that on his trip from Cue, the centre of the Murchison goldfield, to Carnarvon, between the heads of the Woramel and Minilya Rivers, he discovered, associated with carboniferous rocks, an extensive deposit of glacial origin. He traced this deposit over sixty or seventy miles. With it were a large number of ice-scratched boulders.

GENERAL.

EARTHQUAKE OBSERVATIONS.—In his paper on "Seismological Observations and Earth Physics" (*The Geog. Jour.*, Jan., 1903), Mr. John Milne divides earthquakes into two groups: First, those which

disturb continental areas and frequently disturb the whole world as a whole; and, secondly, local earthquakes, which usually disturb only an area of a few miles' radius, and seldom extend over an area with a radius of 100 and 200 miles. He endeavours to show that the former are the result of sudden accelerations in the process of rock-folding accompanied by faulting and molar displacements of considerable magnitude, while the latter are for the most part settlements and adjustments along the lines of their primary fractures. A long series of observations justified Mr. Milne in saying (1883) that "it is not unlikely that every large earthquake might with proper appliances be recorded at any point on the land surface of the globe." This statement was not fully accepted until six years later, when it was found that the photographic records of the displacements of a horizontal pendulum showed abnormal movements that were traced to earthquakes which had originated at great distances from the observing station. From this time seismologists had before them a new field for research, and stations to record world-disturbing earthquakes are now to be found in very many countries. The most complete organization of stations is that working in co-operation with a committee of the British Association. There are now thirty-eight of these stations scattered all over the world, and their seismological observations are published semi-annually.

The British Pacific Cable.—The British cable, laid between Vancouver, British Columbia, and Brisbane, Queensland, completed last fall, is the last link in a girdle of British telegraph lines extending around the world. With the exception of two landing-places in Portuguese territory, at Madeira, and at St. Vincent, on the Cape Verde Islands, all the landings are in British territory. The line between Vancouver and the North Island of New Zealand is over 8,000 miles in length. It is extended from New Zealand to Norfolk Island and Brisbane. Between Vancouver and New Zealand the only landing-places are at Fanning Island and the Fiji Islands. The longest stretch of cable between landing-places is from Vancouver to Fanning Island, 3,600 miles. The greatest depth at which the cable was laid was 19,200 feet, the average depth being 16,200 feet. The cable was opened for business about the middle of December, and it is now possible to send a message around the world in thirty minutes. This great undertaking was not carried out without much opposition, particularly on the part of the cable lines between Australia and the Malay Archipelago which connect with Europe.

WEATHER AND TRAIN LOADS.—A recent number of the *Monthly Weather Review* calls attention to the fact that the load which an engine is given to draw is, in many cases, regulated by the weather forecast. Thus, in the case of freight trains leaving Pittsburg for the West and Northwest, there are four classes of train loads, arranged alphabetically, depending upon the kind of weather which is expected. If the report is for favourable weather, the engine's load (A) is 1,750 tons. When there is a reasonably good weather report the locomotive's load is limited to 1,625 tons (B). Worse weather means a load of 1,475 tons (C), and very bad weather reduces the load to 1,225 tons. In the case of stock trains, Class A is 1,450 tons, and for high-class freight running at higher speed than ordinary freight Class A means 1,525 tons per train. The same allowance is made for the three lower classes as noted above.

R. DE C. W.

EFFECT OF DOUBLE WINDOWS ON TEMPERATURE.—H. Dufour has made a study of the effect of double windows in keeping out winter cold (*Arch. Sci. phys. et nat.*, Geneva). He placed one thermometer in the outside air, about 4 inches away from an east window; another was fastened between the two windows, 1½ inches from the inside window, and the third was in the middle of the room. The space between the windows was 8¼ inches. The results of observations during one winter were as follows:

OUTSIDE.	BETWEEN WINDOWS.	DIFFERENCE.	ROOM.
25.2° calm	37.4°	12.2°	56.3°
23° moderate wind	35.6°	12.6°	59°
17.6° high wind	33.3°	15.7°	57.2°
23° " "	38.3°	15.3°	55.4°
30.7° calm	41.0°	10.3°	57.2°

The differences were 11–13° in calms, and rose to between 15° and 16° when there was a high wind.

R. DE C. W.

IMPROVEMENTS TO NAVIGATION IN THE GULF OF ST. LAWRENCE.

BY

LIEUT.-COL. WM. P. ANDERSON,

M. Can. Soc. C.E., Chief Engineer Department of Marine and Fisheries, and General Superintendent of Canadian Lighthouses.

Within the past three or four years there has been considerable discussion in the public press respecting deficiencies in aids to navigation in the Gulf of St. Lawrence, prompted by the large number of casualties on this great Canadian route and the consequent high rate of marine insurance. While investigations into past wrecks have demonstrated that the blame lay rather with the culpable ignorance and negligence of sailors and the defective system of pilotage than with aids to navigation, the agitation has had the good effect of inducing Parliament to vote liberal subsidies for the extension and improvement of the lighthouse and fog alarm service.

The lights in the St. Lawrence are not, it is true, strictly first-class, having been built under exceptional conditions. When the Dominion Government was organized in 1867 there were very few aids to navigation of any kind, and the Minister of Marine of that day was confronted with the problem of efficiently lighting one of the longest coast-lines in the world out of a very slender purse. He wisely decided to put up a large number of cheap wooden lighthouses, provided with economical yet fairly effective apparatus, rather than a small number of expensive aids. The result was at that time eminently satisfactory; but with increased speed of steamships, and with the strenuous competition which compels navigation even through the thickest fog, the time has arrived when more quickly-flashing lights and the most powerful fog-signals must replace the aids that gave such good service in the past. It is consequently contemplated to do a great deal of work in improving aids to navigation on this route during the coming season. A first-rate quick-flashing light and powerful fog siren are being built on the north-east end of the island of Belle Isle to mark the gateway to the more northerly entrance to the Gulf. A modern steam lightship is being built to mark the dreaded east end of the island of Anticosti. Cape Rosier light is being increased in power and made occulting. At

Fame Point, the landfall steered for in crossing from Anticosti, a fog alarm was installed last year. This is one of the Hamilton-Foster sirens, which give out different signals to the several cardinal points, and is established on trial, as the principle is yet considered to be in the nature of an experiment. At Matane a first-class siren will be established this year; and at Father Point, which is important as marking the limits of the pilotage ground, a first-class siren has just been installed. These are only some of the changes already made and in contemplation, and are merely quoted as instances of the class of work in which the Government is now engaged. When they are completed, it will be possible, with ordinary good seamanship, to navigate the St. Lawrence safely under any conditions of weather.

The fog alarms now in course of installation are the most powerful of their kind in the world. They are either sirens, or modifications of sirens, of the largest size, operated by compressed air, and will undoubtedly give satisfaction if mariners can be taught that sound signals are always liable to aberration, caused through want of homogeneity in the atmosphere. Lack of knowledge of this physical law is probably the cause of more wrecks than any other single factor in recent marine disasters.

The recent invention of a lamp to burn vaporized petroleum under an incandescent mantle promises to furnish an extremely powerful light at a minimum of care and expense. It is a moderate estimate that coal oil so treated will produce ten times the light that can be got out of it when burnt under ordinary conditions. This petroleum vapour-burner is being adopted for the latest Canadian lighthouse installations.

Last year the system of telegraph lines and cables built and maintained by the Government as aids to navigation was completed by their extension to Belle Isle, the island itself being connected with Labrador both by cable and etheric telegraphy. The whole of the Canadian coast of the Gulf, including the island of Anticosti, is, therefore, in direct telegraphic communication with shipping centres. These lines are operated at a heavy loss expressly for the benefit of shipping. The general adoption of an etheric telegraph system is now under consideration by the Canadian Government.

A comprehensive system of tidal stations has also been established throughout the Gulf and on the Atlantic coast. This enables reliable tide-tables to be issued for the harbours, with which the tidal streams of the St. Lawrence are brought into relation. The currents in the Gulf have been investigated in a general way, and

the work is being continued. The results already obtained prove that there are no currents in the open Gulf much exceeding one knot—a rate practically inappreciable by modern steamers. Much misapprehension formerly existed on this point, which should be removed by the extensive publication of the results. As these have been summarized in all the leading maritime periodicals, ignorance of them by sailors is inexcusable. It is unnecessary to emphasize the importance to the navigator of reliable information of this character.

FOREST RESERVE IN THE SOUTHERN APPALACHIANS.

No more interesting Government report has been issued in many years than that here noticed bearing the title:

Message from the President of the United States, transmitting Report of the Secretary of Agriculture, in relation to the Forests, Rivers and Mountains of the Southern Appalachian Region.

The President's Message is short but emphatic, and the Secretary's Report, going somewhat into detail, is followed by appendices, with full treatment of special themes.

A reserve in this region was first urged upon Congress in 1900, by the Appalachian Mountain Club in New England and by the Appalachian National Park Association of the Southern States, and the sum of $5,000 was at once appropriated for investigation. The needed field studies were made in 1900 and 1901, and were far more extended than could be provided for by the appropriation, owing to the vigorous co-operation of the United States Geological Survey. The work covered parts of six States.

The Southern Blue Ridge and the Unaka Mountains are described—the highest region in North America that is covered by hardwood forest. The river bottoms and water-powers of the Piedmont Plateau depend on the regularity of the streams rising in these mountains, and such regularity hinges, in turn, upon the preservation of the forests. No glacier has invaded the region, the rainfall is abundant, and the development of the forests has been unimpeded for geological periods, until now 137 species of trees are found there, and a still greater variety of shrubs.

The variation of altitude is great enough to affect the distribution in a marked way: On Mount Mitchell, oak, hickory, maple, and

chestnut grow at the base, followed by hemlock, beech, and birch; while above are spruce and balsam, and higher still are shrubs and dwarfed trees. The humus is often a foot or more in thickness, a formation all-important, easily washed away, and not to be replaced in centuries, if at all. Many slopes have been cleared, cultivated a few years until the soils were run out, and then abandoned.

The lumbermen have sought the rarer woods, or in many places have cut everything that would sell, felling the desired trees without regard to what they would crush, and leaving the waste to propagate destructive forest fires. So far have the ravages gone that it would be too late, after another decade, to save these splendid forests. Not more than 10 per cent. of this mountain land has slopes of less than ten degrees, and yet 24 per cent. of it is already cleared, exposing great areas on hillsides that should have been allowed to keep their protective cover. Grass, forming a strong turf, will not here, as in the cooler climate of New England, bind the soils from washing.

The soils, even of the valley farms, are removed by the floods, and many thousand acres of rich bottom lands were in this way damaged, or ruined, during the year in which the report was written. The forests and the farms, therefore, can only be rescued by setting the region apart as a public reserve. There is also more than a million horse-power of undeveloped water-power available along the streams of this region. The uniformity of flow is in exact ratio to the preservation of the forests, and, where cutting has been excessive, water has often had to be supplanted by steam. It is a question of water storage; and as there was no ice invasion, and as there are no lakes, the humus cover is the sole means of hoarding the waters and doling them out so as to serve the millwheel and save the field.

Being a region of heavy rainfall, floods will be great and enormously destructive. A single storm at the sources of the Catawba River, in May of 1901, ravaged the lower river country for more than 200 miles, and cost the farmers one and a half million of dollars. Another storm in August of the same season did another half million dollars of damage. The May floods of the entire region carried the losses to $7,000,000, and, adding the other floods of the year, the destruction of property in 1901, in the Southern Appalachians, amounted to $10,000,000. National reservation is the only means of averting such stupendous calamities, for the States concerned are not able to bear the financial burden; and, moreover, the separate States, as North Carolina, give rise to the streams whose havoc

is mainly wrought in other domains. We cannot expect one commonwealth to tax itself for the benefit of its neighbours. The Federal Government should not delay to act upon the matter; and it is believed that, with good forest management, such a reserve should soon become self-supporting.

Appendix A contains several papers descriptive of the forests and forest conditions, including, also, lumbering, accounts of the forest areas by river basins, and a list of native shrubs; Appendix B, by Arthur Keith, of the Geological Survey, deals with the topography and geology; another supplement is devoted to hydrography, and a fourth to the climate. The Report closes with matters pertinent to immediate action in setting apart a reserve. Here are memorials from several scientific and business associations, a report of the Senate Committee, resolutions and acts by the legislators of Virginia, Tennessee, Georgia, and the Carolinas, and a large number of extracts from the press.

After all, the reader will, perhaps, be most deeply impressed by the rich outfit of illustration, showing forests, typical Appalachian views, and, especially pictures of the havoc wrought on slopes and bottom lands by rainwash and resistless floods.

A. P. B.

EARTHQUAKE AND VOLCANIC CENTRES IN THE PHILIPPINES.

This sketch map, showing the distribution of earthquakes and their relative frequency throughout the Philippines, and also the active and dormant volcanoes in the archipelago, has been compiled from two maps in the report recently prepared in Manila by M. Saderra Masó, S.J., Assistant Director of the Philippine Weather Bureau. The information embodied in the map was collected by the Meteorological Station at Manila, and embraces complete records of seismic phenomena for the past eighteen years. Twelve of the volcanoes here shown are more or less active. They include Babuyan, Camiguin, and Didica, in the Babuyanes Islands, north of Luzon; in Luzon, the great volcanoes of Mayon and Taal, besides Bulusan and Bacon; Malaspina, on the island of Negros; Camiguin, on the island of the same name off the north coast of Mindanao; and on Mindanao the volcanoes of Apo, Macaturin, and Calayo.


DISTRIBUTION OF THE EARTHQUAKES.
Very rare
Rare
Almost frequent
Frequent
Very frequent
Active Volcanoes
Dormant "
SCALE OF MILES
0 20 40 60 80 100 120
Babuyan
BABUYANES
Didica
M.Camiguin
M.Caua
LUZÓN
M.Arayat
POLILLO
Manila
Maquiling
M.Banajao
M.Sungay Vol.
Taal
LUBANG
CATANDUANES
M.Ysarof
Mayon
Vol. Bacon
Vol. Bulusan
MARINDUQUE
BURIAS
ROMBLON
MINDORO
TABLAS
SIBUYAN
TICAO
BUSUANGA
YLING
CARABAO
MASBATE
SAMAR
CALAMIAN
BILIRAN
M.Guinon Vol.
LINIPACAN
PANAY
M.Acudining
LEYTE
PARAGUA
CUYO
Iloilo
CEBU
Cebu
Canlaon
DINAGAT
DUMARAN
GUMARAS
SIARGAO
NEGROS
BOHOL
M.Mainit
Caladias
Vol Camiguin
CAMIGUIN
SIQUIJOR
MINDANAO
M.Dinata
M.Macaturin
Calayo
Vol.Apo
BASILAN
M.Butulan
Vol. Sarangani

The most famous Philippine volcano, and one of the finest volcanic cones in the world, is that of Mayon. Its height is 8,970 feet, and the volcano is visible at a great distance. Since 1766 records have been kept of its eruptions. In that year many plantations and villages were buried under a stream of lava which flowed down its eastern slope. About 1,200 lives were lost in the eruption of 1814, which buried the country around a part of the base of Mayon under the outpourings of lava and dust. A similar calamity in 1825 destroyed the lives of about 1,500 persons. In the nineteenth century there were a number of severe eruptions, including one in 1886–87, which continued about nine months; an eruption in 1897 killed 350 persons and destroyed much property. Twenty-two violent eruptions of this volcano are on record.

Next to Mayon, the Taal volcano is the most remarkable. It is on an island in the Lake of Bombon, and the island, built up by its outpourings, has an area of 220 square miles. The volcano is incessantly ejecting dust and vapour from its crater. Taal, as well as Mayon, has been the centre of numerous destructive earthquakes; but no very great eruption has occurred since 1864, when four villages around the mountain were completely destroyed.

Some of the volcanoes are not given to violent outbursts. Apo, in Mindanao, for example, a majestic mountain rising 10,311 feet above the level of the sea, gives evidence of its activity only by numerous solfataras, or jets of sulphurous vapours. Macaturin is not known to have had more than two eruptions since the arrival of the Spaniards in the sixteenth century. Calayo is also in the solfataric stage, sulphurous vapours issuing not only through the crater but also along the steep banks of the neighbouring river. Camiguin has a cone that was formed almost entirely during the eruption of 1871, since which time its activity has gradually abated.

Manila is well situated for experiencing nearly all the earthquake shocks radiating from the different volcanic centres of Luzon. It stands on alluvial soil, which is usually more violently disturbed by earthquakes than the underlying rock, and it is only thirty-five miles north of the active volcano Taal.

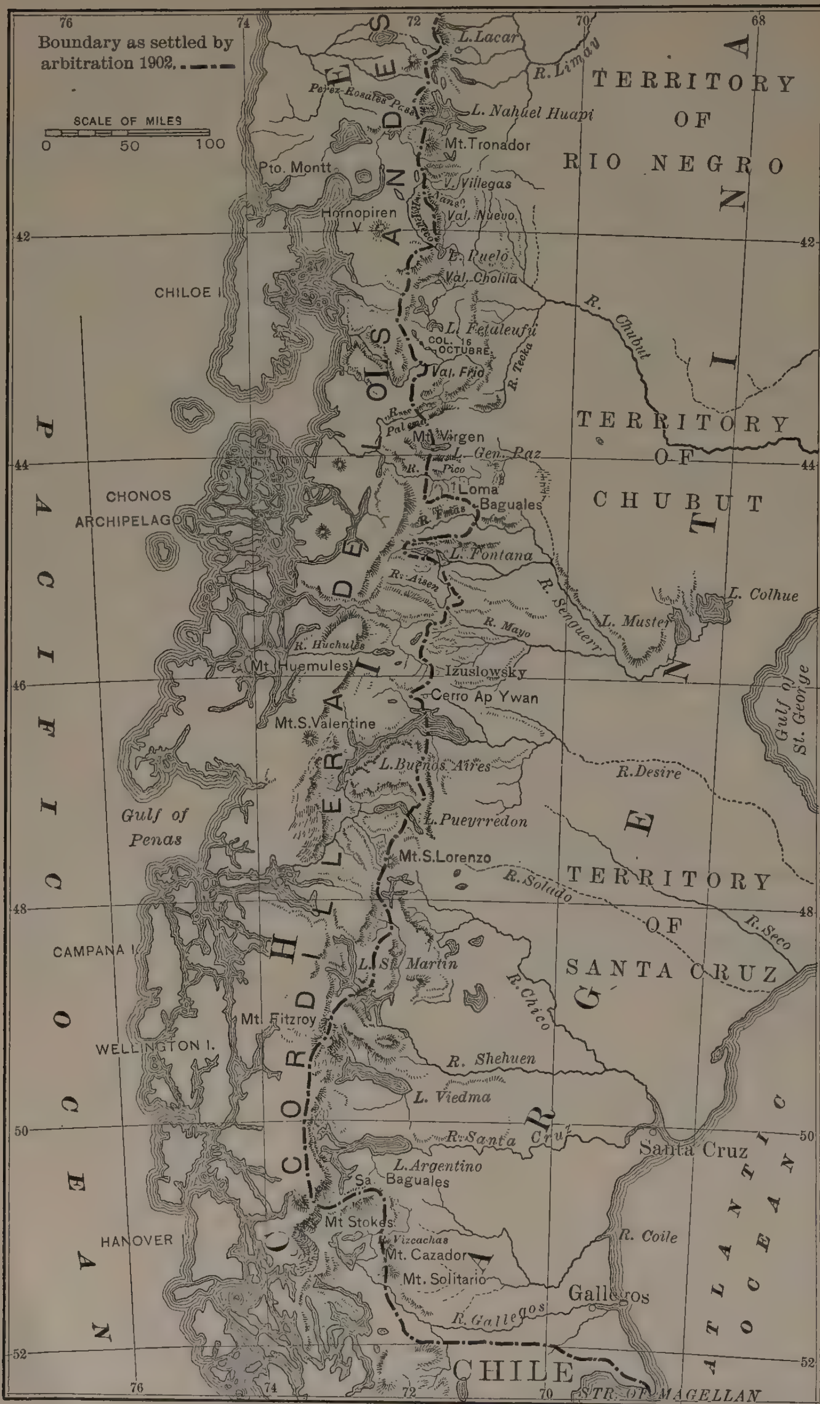
THE BOUNDARY BETWEEN CHILE AND ARGENTINA.

The long dispute between Chile and Argentina over their boundary has been brought to a satisfactory conclusion by the award of King Edward VII. of Great Britain. The King's decision, determining the position of the boundary line, is based upon the recommendations of the Arbitration Tribunal that has been studying the questions involved for the past two years. The position of the boundary as now settled is shown in the accompanying map. It is a compromise between the respective claims of the two countries.

Under the arbitration Chile gains more territory than falls to Argentina, particularly in the southern portion of the region that was in dispute; but the territorial gain for Chile is at least of no greater importance than the smaller area which Chile claimed, and which has been conceded to Argentina.

The disputed region among the Southern Andes, which is now largely assigned to Chile, is not adapted for important development; while the Welsh Colony of Diez y Seis de Octubre and the Nuevo and Cholila valleys shown on the map to the north of it, now definitely assigned to Argentina, are rich regions with fine soil and abundant grasses, capable of large development, both for the agricultural and grazing industries.

Chile, on the other hand, secures a large amount of fine forest land, and also uplands in Patagonia, well adapted for sheep-raising, which Argentina had claimed. On the whole, it is doubtful if a fairer award could have been made; and the two countries are to be congratulated upon the settlement of a dispute that had become prejudicial to their business interests.



NEW BOUNDARY BETWEEN CHILE AND ARGENTINA.

NEW MAPS.

AMERICA.

NORTH AND SOUTH AMERICA. Colonies Allemandes en Amérique. *Revue de Géographie*, January, 1903. Paris.

A sketch map showing the areas of largest German population in North and South America; with an inset showing the German colonies in Brazil colored according to density of population. The German colony in South Chile is not indicated. All the steamship connections between Germany and American ports are given.

UNITED STATES. The Stieler six-sheet map of the United States; comprising sheets 86, 87, 88, 89, 90 and 91 of the Ninth Edition of Stieler's Hand-Atlas. Gotha. Justus Perthes, 1902. (In German.)

Although only about one-fourth of the sheets of the ninth edition of the Stieler Hand-Atlas has as yet been issued, the published portion includes the six-sheet map of the United States. This map has long been worthy of the special attention of our citizens as the best foreign map of this country. The scale, 1:3,700,000, or 57.84 statute miles to an inch, is not large enough adequately to show the country in its more minute geographical relations, but for most purposes the map is superior to many published in the United States. The new edition differs much from its predecessors, particularly in the methods employed for showing topography. In earlier editions colour was used almost entirely to denote boundary lines; in the present map the hill hachuring is emphasized by brown tints, so that all the higher elevations stand out in bold relief. The most striking change, therefore, is that the new map presents topographic aspects more vividly.

The heights were formerly shown in English feet, but they now appear in metres—an innovation that may not be enthusiastically received here, as we are not yet accustomed as a people to the metrical system. Hundreds of heights above sea-level are given for lakes and mountains. Place names have five different symbols to indicate approximately the size of each town according to the last census. It is evident that the sheets of the topographic map which the United States Geological Survey is making have been utilized to present the latest ascertained facts. For example, the Catskill sheets, thus far issued, have helped to improve the delineation of that region on the new Stieler map. Little streams, like the Schoharie and Batavia, are traced from source to mouth, though there is no room to print their names; and their drainage basins are plainly defined by the distinctly-marked hill features.

Three scales are given, nautical and English miles and kilometers. Sand areas are tinted yellow and lakes appear in blue. The Territories are distinguished from the States by differently indicating their boundary lines. An excellent idea of the large amount of information that may be presented on a small scale map may be obtained by observing on these sheets the lighthouses, sand banks and reefs along the coast, the conspicuous delineation of national parks, Indian and military reservations, leading mining districts, chief lines of railroads and telegraphs and hundreds of heights above sea-level for the lakes and mountains. To present so much information it is, of course, necessary to eliminate many place names, though the nomenclature, considering the scale, is certainly large.

All map lovers in our country will enjoy the study of this admirable product, which scientifically presents the best attainable information.

New Jersey.—Geological Survey of New Jersey. Trenton East and Atlantic City sheets. Scales in feet, metres and miles, 2⅝ inches to a mile. Contour interval 10 feet. Edition of 1902. C. C. Vermeule, topographer; Henry B. Kümmel, State Geologist, Trenton.

The areas covered by these sheets were resurveyed in 1901. The street plan of the towns is clearly shown on so large a scale.

AFRICA.

The Congo River.—A map of the Congo River between Leopoldville and Stanley Falls—Scale 1:250,000, or 3.9 statute miles to an inch. By the Rev. George Grenfell. *The Geographical Journal*, 1892, sections 1, 2 and 3 in November, and 4 and 5 in the December number.

Grenfell's running surveys of the navigable upper Congo between Stanley Pool and Stanley Falls, made in the steamers *Peace* and *Goodwill* (1884–89), have at length seen the light. The Royal Geographical Society has rendered a distinct geographical service in publishing this carefully-prepared material, which is a very valuable addition to the mapping of the Congo. The courses and bearings were laid down from some 200,000 cross bearings; about 1,500 altitudes were observed for latitudes and about 1,200 for time and longitude. All channels between islands more than a half mile in length excepting those indicated by dotted lines have been navigated. Indications of the topography along both banks of the river are given as far as Bolobo. The index chart performs an additional service by showing along the courses of the five southern tributaries and the Mobangi (northern tributary), which Grenfell explored, the date and place of publication of his maps of these discoveries.

West Africa.—Essai de carte des Régions Botaniques d'Afrique Occidentale—Scale, 1:15.000.000, or 235.3 statute miles to an inch. By A. Breschin. *La Géographie*, 1902, No. 4.

Indicating the areas occupied by the principal kinds of trees from the west coast between Senegal and Angola to Central Africa—the oil palm, the kola, and the shea or butter tree; also the southern limit of the date and Egyptian palms, and the northern limit of the borassus palm and the banana.

Africa, General.—Cinq Cartes d'Afrique. Nouvelle édition, 1903, par M. le Général Niox, en un fascicule. Paris. Librairie Ch. Delagrave. Price, 6 fr.

These five sheets from General Niox's Atlas de Géographie Générale, revised to date and issued as a special number, will be welcomed by students of Africa, and are of special interest to the French nation, as all the sheets, except on the general map, relate to parts of the continent in which France is most concerned. The latest data as to political boundaries, discoveries and corrections are given, but the well-known house of Delagrave does not yet seem to have heard that the former Boer republics have passed under British sovereignty. The maps are: Afrique—Scale, 1:16.000.000, or 251 miles to an inch; Algérie et Tunisie—scale, 1:2.000.000, or 31.5 miles to an inch; La Région Saharienne Française—scale, 1:4.000.000, or 63.1 miles to an inch, showing the desert routes along which French enterprise is being extended towards the Sudan, Senegal, and Niger regions—scale, 1:8.000.000, or 126.2 miles to an inch; Congo-Nil—scale, 1:8.000.000, or 126.2 miles to an inch. This map contains considerable new geographic information, particularly with regard to the inland portion of the French Congo.

ASIA.

SIAM AND MALACCA.—Siam und die Halbinsel Malakka—Scale, 1:12.500.000, or 197.2 statute miles to an inch. Deutsche Rundschau für Geographie und Statistik. 1903. Heft 4.

Showing in colors the new French-Siamese boundaries and the French and English spheres of interest in Siam.

COREA.—Seoul sheet of the map of Asia, now in course of publication by Le Service Géographique de l'Armée. Scale, 1:1.000.000, or 15.78 statute miles to an inch. Paris. Price 1 f.25 cent.

Corea is usually presented in atlases on a scale too small to indicate much detail, though the native maps, as well as foreign studies, have supplied a large amount of valuable material. This sheet shows nearly the whole of Corea, with a large number of place names, many roads, and topographic features differentiated by light and shadow. Sea depths along the coasts, and across Corea and Broughton Bays, are shown by contours and soundings. The production of these useful maps is worthy of all encouragement.

ASIA MINOR.—Regenkarte von Klein-Asien. By Dr. R. Fitzner. Scale, 1:3.700.000, or 58.3 statute miles to an inch. *Petermanns Mitteilungen, Ergänzungsheft* No. 140, 1902. Gotha. Justus Perthes.

Showing in six tints the average amounts of precipitation throughout Asia Minor, and illustrating Dr. Fitzner's monograph on rainfall and cloudiness in Asia Minor, to which this *Ergänzungsheft* is devoted.

ATLASES.

STIELER'S HAND-ATLAS. Neue, Neunte Lieferungs-Ausgabe. 100 Karten in Kupferstich. 9 and 10 Lieferungen. Gotha. Justus Perthes. Price, 60 pf. for each part containing 2 map sheets.

This double part contains four sheets: No. 37, the northern sheet of a map of Great Britain, drawn by O. Koffmahn. Scale, 1:1.500.000. A new map, with insets of the Scottish Lowlands, Edinburgh and its surroundings, and the Orkney and Shetland Islands. No. 67, Islands of the East Indies, by C. Barich. Fourteen maps on one sheet (new), of the leading islands and island groups, on a scale of 1:7.500.000, or 118.3 statute miles to an inch, for the leading islands. Small as this scale is, it is larger than that of most atlases for this part of the world, and larger than that of the maps of the Philippines, Borneo, Sumatra and Celebes hitherto presented in this Atlas. A map of the Philippines, for example, on a scale of 118.3 miles to an inch, as on this sheet, is too small to serve adequately the purpose of even ordinary newspaper reading. To give only one illustration of this fact, not half of the eleven more or less active volcanoes of the Philippines are shown on the map; and no one could deduce the fact by studying this map that the great Taal volcano lies in the middle of Lake Bombon. The attention of cartographers may properly be called to the "Report on the Seismic and Volcanic Centers of the Philippine Archipelago" by M. Saderra Masó, S.J., Bureau of Public Printing, Manila, 1902.

ATLAS UNIVERSEL DE GÉOGRAPHIE. Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. No. 3-Mappemonde. No. 19-Espagne et Portugal en 4 feuilles (feuille sud-ouest). Scale, 1:1,250.000, or 19.7 statute miles to an inch. Paris. Librairie Hachette et Cie. 1902.

The accurate information and the sharp and clear definition of topographic

features presented on the sheets of this Atlas make it all the more regrettable that the interval between the publication of the sheets is so long. It is about eighteen years since the first sheets were published, and twenty-six of the ninety sheets still remain to be issued. The whole of Europe has appeared excepting the general maps of the British Islands and Iberian Peninsula and the southeast sheet of Spain and Portugal in four sheets. Nine of the fourteen sheets of Asia, six of the twelve sheets of Africa, six of the twelve sheets of North America, and the whole of South America and Oceania have been issued. No. 3 is a hypsometric map of the world in hemispheres, six colors showing land altitudes and six tints of blue indicating sea depths, with smaller maps giving meteorological and climatological data, zones of vegetation, and ocean currents. No. 19 is the southwest sheet of the four-sheet map of Spain and Portugal, with inset maps of the Canaries and Azores.

PHYSIOGRAPHIC NOTES.

BY

RALPH S. TARR.

River Piracy in Southeastern Missouri.—Although it is probable that the last word on Crowley Ridge has still to be said, Marbut (University of Missouri Studies, Vol. 1, No. 3, 1902) has done much to clear up the problem which this interesting upland presents. Written upon by Call and by Branner, and studied later by Marbut, while a student at Harvard, the Crowley Ridge presents problems that have led Marbut to extend his investigations and survey over a period of four years, and it is with the results of this study that his present paper deals. He arrives at substantially the same general conclusions that Branner reached in 1889, bringing forward additional evidence in many cases, and contributing pertinent facts as well, concerning the processes of stream development and river capture.

The area discussed lies in Missouri, near the confluence of the Mississippi and Ohio, and consists of two main areas of lowland, separated by several upland ridges, of which the Crowley Ridge is the largest. The lowland between Crowley Ridge and the Ozark Upland is an abandoned valley of the Mississippi, which formerly joined the Ohio some distance below their present junction at Cairo. Marbut's studies show that the Mississippi cut this inner bottomland, while the much larger lowland area east of Crowley Ridge was made by the Ohio. The Mississippi was, later, twice diverted from its course, eventually entirely abandoning its lowland, being

diverted through the narrow gorge into which the river sharply turns just below Cape Girardeau.

That a stream so much larger than the Ohio as is the Mississippi should have been able to make a lowland belt very considerably smaller than that developed by the smaller stream would naturally invite an investigation of the causes and influences to which the streams have been subjected; and when the further facts are considered that the Mississippi has twice left its developed course, abandoning in the first case 200 miles and in the second 50 miles of its valley to flow through a narrow gorge which had to be wholly readapted to fit its new occupant, and that the latest turning aside is so recent that Paleozoic rocks in the stream course still form a dangerous rapid, the "Grand Chain" just below Cape Girardeau, it seems worth while to look into the causes which result in stream capture generally, and especially those which have operated here. The twice-repeated filching of the larger stream by the smaller has resulted from the combination of favourable conditions and suitable intervals of time for their operation.

Marbut shows that the development of the larger lowland by the Ohio is due to the fact that it was working in soft, unconsolidated rocks, the Tertiary clays and gravels and Pleistocene loams and loess, while the Mississippi was held up by the indurated Paleozoic limestones and sandstones of the Trenton. Moreover, the Mississippi has a steeper grade than the Ohio; it was not relieved of its heavy burden by the melting back of the ice-sheet from its headwaters until after the Ohio, and it was never relieved of the loads of sediment dumped in by the Missouri. Consequently the Ohio has been able to push back its divide into the drainage area of the Mississippi and rob it of some of its tributaries. The Mississippi, cutting against the low divides thus formed, has pierced the valley of its own captured tributaries at a low enough point to be diverted into the lower valley, and hence into the Ohio itself. Thus, in re-capturing its captured tributaries the Mississippi has

found it necessary to abandon two valleys in succession, after each was eroded down to grade and opened out to a width of several miles, in favor of the valleys of small creeks, which it had to work over and enlarge in order to make them suitable for its purpose.

The writer discusses the diversion of each of the several creeks, giving an excellent discussion of river capture. How capturing was done is summed up in the following quotation:

The valleys of two streams are separated by a narrow belt of upland. A small stream flows into one of them, heading on the upland between the two main streams. That one of the larger streams into which the small stream does not flow saps

the bluff on the side nearest the other large stream, gradually working toward the head of the small tributary. By continued sapping it finally cuts off the head of the tributary; then, continuing, cuts off more and more of it, reaching a lower and lower level of its valley, thus deepening the gap between its valley and that of the other large stream. It finally reaches a point where it can shorten its course by flowing into the other stream through the beheaded trunk valley of the tributary, abandoning the lower part of its own valley.

Other interesting physiographic points brought out by the paper concern themselves with questions incidental to the main problem, among which the beheading of the Crowley Ridge drainage may be noted. The work has been exhaustive; some of the applications are ingenious; they all seem rational.

The Origin of Hanging Valleys.—Professor Davis's recent paper on the hanging valleys of the Alps and elsewhere, in which he explains them by glacial erosion, has called forth two papers opposing his explanation, one by Bonney (*Quarterly Journal Geological Society*, LVIII, 1902, 690–702), the other by Garwood (Same, 703–718). Bonney's paper opens with a criticism of Professor Davis's methods, stating essentially that he had hurried over the region and jumped at a conclusion. Those who are more familiar with Professor Davis's powers and methods are aware of the fact that he was prepared for his investigation by a long previous study of Swiss topographic sheets and by a long and diverse experience in the study of the physiography of many regions. Moreover, Professor Davis's training and powers are such that he is able to see where others do not.

That Bonney is not in sympathy with the development of physiography that has been made in the United States is shown by a number of passages in his paper. He, for example, states that he prefers the old term dip and strike valleys in the place of the newer consequent and subsequent, as if these terms were really synonymous.

The paper by Bonney is prefaced by some remarks concerning the earlier history of the Alps. He holds that the action of snow is conservative rather than destructive, that cirques and overdeepened valleys have been formed by running water, and that the erosive work of ice has been on a small scale, such as the formation of shallow basins and roches moutonnées. On the other hand, he points out the fact, to which every one will agree, that water is known to have the power of excavating, and, moreover, that its work can be seen. Therein appears to lie the chief difficulty that stands in Bonney's way—namely, that he cannot see ice erosion in

progress. He seems to hold that because small glaciers near their margins are not at the present time doing great tasks of erosion therefore ice has never done much work of that sort.

His view of the origin of the hanging valleys is as follows: The Alpine valleys are almost wholly preglacial, the gorge cutting dating from late Pliocene times. The hanging valleys are due to the fact that glaciers remained in the side valleys, thus checking denudation, while the downcutting of the main valleys was increased by the torrents of water coming from the melting ice. He cites many instances in support of this view, and concludes that, while Professor Davis's hypothesis derives little support from the facts, his own hypothesis is far better supported.

Garwood's paper is, in general, similar to Bonney's, though he seems to have more respect for Professor Davis's work. In fact, he says that Davis states the facts regarding the Ticino valley correctly. His attention was first attracted to hanging valleys in the Himalayas, and he has studied the Ticino and numerous other valleys. According to his interpretation, the region of the Ticino valley was uplifted, and the hanging valleys produced, probably during interglacial times, being occupied, as Bonney has suggested, by glaciers, which preserved them. He concludes that ice is a weak agent of erosion, from observations he made at the ends of the glacier in Switzerland and in the Arctic. It seems exceedingly strange to find two men applying criteria from the weak ends of small glaciers in the interpretation of work done by deep ice moving vigorously over a region. It is much like examining a small stream flowing through a meadow and from it concluding that a river could not cut out a Colorado cañon. To interpret correctly the work performed by great ice masses, one must divorce himself from prejudice at the outset and be ready to accept the result of observed fact; no matter what his preconceptions may have been concerning the powers of the agent. Perhaps there is no one who would hold that ice is not protective when compared to the work which is done by rivers; but to admit this is far different from holding that, while ice protects a valley which it occupies, it is nearly inactive.

After reading these two papers the physiographer cannot help wondering whether either of the authors is in sympathy with the basal principles of the new physiography. For example, Mr. Garwood speaks of the hanging valleys of the Italian lakes, mentioning especially the one at Menaggio, on Lake Como. These he ascribes to the holding up of lake waters while the hanging valleys developed

at that temporary base level. Lake-lowering, then, allowed the hanging valleys to be downcut. This process is truly a possibility; but one is warranted in asking several questions. Has time enough elapsed since the lakes were formed to permit the formation of the broad valley that hangs above Lake Como at Menaggio? It has a mature form. The required time for so mature a valley must have been great enough for the lake to be nearly or quite filled. The gorge which now takes the water through this hanging valley into Lake Como is young enough to be postglacial in age. Where, then, are the lake beaches and deltas that were formed at this higher level? And what accounts for the depth of the Lake Como valley below the level of the hanging valley? These are physiographic difficulties which seem utterly opposed to Garwood's explanation.

The hypothesis that hanging valleys were caused by the protection of ice tongues brings forward one or two difficulties which seem far more serious than that of explaining how ice can erode. The over-deepened valleys to which the hanging valleys are tributary are quite wide and U-shaped; that is, their form is such that, if formed by water, no small amount of time has been required. During this time the hanging valleys must have been filled with ice tongues almost down to the edge of the main valley. This requires a period of stability in ice position quite unlikely to occur. If the ice tongues did not nearly fill the hanging valleys during the deepening of the main valleys either one of two things must have happened: (1) Either the outrush of water must have cut gorges, or (2) the water must have been so overburdened with sediment as to have built wash deposits. The absence of either of these evidences of ice occupancy is certainly suggestive. It seems like appealing to a most unnatural cause to explain what is far more simply explicable by ice erosion.

Finally, and as a very strong argument in favor of ice erosion, is the fact that well-defined cirques and over-deepened and hanging valleys are among the common features of glaciated regions, while they have so far not been reported in unglaciated regions. Moreover, there are hanging valleys in many places where the theory of protective ice tongues could not even be advanced; for example, in the hanging valleys tributary to the Lake Cayuga valley, in central New York. In unglaciated regions side valleys are in harmony with the main valleys. The Colorado River, for example, is rapidly cutting along its bed. Its small tributaries are weak in the extreme, being free from water during a large part of the year; yet at their

mouths they are able to keep up with the vigorous work of the main stream.

In these comments on the two papers I do not bring forward again the statement regarding overlapping spurs which Professor Davis brings out in his paper. From what Bonney and Garwood say it seems evident that neither of them appreciates the full significance of this evidence in favor of glacial erosion.

THE HUICHOL INDIANS OF MEXICO.

BY

CARL LUMHOLTZ.

There are living to-day in Mexico about fifty different tribes of Indians, each speaking its own language. Besides, over a hundred and fifty dialects are spoken, so that in all there are in use in that Republic as many as two hundred idioms, none of which is understood by those who speak the others. This diversity of language is partly due to the taciturnity and exclusiveness of the Indians.

In this conglomeration of tribes four were found, at the time of the Conquest, to be far superior to the others, and in possession of a remarkably high culture. These were the Aztecs, the Mayas, the Mixtecs, and the Zapotecs. When the Spaniards invaded Mexico they found these tribes practicing the art of picture writing in their peculiar books, as well as on their stone monuments. Their wonderful architecture and sculptures, the high development of their governmental and religious systems, the barbaric splendour and wealth in which these nations lived, not only baffled the invaders, but the better they become known to the civilized world of the present age the more they excite wonder and admiration. In many sciences, especially in botany and astronomy, these so-called barbarians were in advance even of the Europe of that time. Yet at the very doors of these highly-advanced races there dwelt tribes, such as the Huichol Indians, whose limited intellectual power forced them to remain mentally and socially in an absolutely primitive condition. Strange as this may seem, the fact in itself is by no means unique. Similar instances of wide diversities of culture

existing side by side may even to-day be observed in all the South American republics and in several European countries. It would be as unjust to judge a Filipino from some low-grade Negrito tribes of those islands as it would be to take for a representative American a Moqui Indian dancing with a rattlesnake in his mouth.

The Huichols, although related to the Aztecs, belong to those tribes that remained undeveloped while the Aztec Empire rose and flourished. Montezuma's reign came to a terrible end nearly four hundred years ago; while the humble Huichols have maintained themselves to the present day in their inaccessible mountain fastnesses. True, they, too, were conquered by the Spaniards in the course of the last century; but the impression the victors made on them was so superficial that to-day the tribe practically dwells in the same state of barbarism in which it resided prior to the time when Cortes first set foot on American soil.

These people occupy a small portion of Central Mexico towards the Pacific slope, and number about four thousand souls. They are called by the Mexicans "los Huicholes"—a corruption of the tribal name of "Vīrárika," which signifies "doctors" or "healers"—a name they fully deserve, as about every third man of them practices that profession. The region belonging to them is, I should judge, some forty miles long by twenty to twenty-five miles wide, and covers the southern spur of the great Sierra Madre range. Of their country the Jesuit Father Ortega says:

> It is so wild and frightful to behold that its ruggedness, more than the arrows of its inhabitants, took away the courage of the conquerors; because, not only did the ridges and valleys appear inaccessible, but the extended range of towering mountain peaks confused even the eye.

Franciscan missionaries followed the conquering soldiers, and built four churches. Nominally, the tribe became converted to Christianity; but to-day the churches are in ruins, while the old beliefs, customs, and ceremonies retain an unshaken hold on the minds of the people.

On a morning oppressively hot, in the beginning of June, 1895, I found myself on the way to that country, accompanied by four Mexicans and one Cora Indian. We were on the slope of the mountains that form the western barrier of the country, which has the reputation of being accessible only at four points. We had still several days' climbing before us, and were just packing our mules, when the father of one of my Mexicans came running up to us with a message that seemed quite alarming. News had reached the valley we had left on the day before that the Huichols were up in arms

against that white man—meaning myself—and determined to prevent his entering their villages. The messenger impressed upon my men the necessity of turning back, and implored them not to run any risk by accompanying me. The men immediately stopped packing, and proposed to go back at once. They declared that the Huichols were bad; that they were assassins, and would kill us all.

By dint of much persuasion and some threats I managed to keep my company together, and four days later we arrived at the pueblo of San Andres, where we found a great many Indians gathered on the occasion of a rain-making feast.

I had sent a man ahead to advise the people that I was coming; that I meant no harm to them, and that their neighbours, the Cora Indians, had received me well. Nevertheless, a few were so put out at the unusual appearance of my expedition that they threw down their sombreros and fled into the forest. But the main part of the population received me in a stolid silence, accepting my baneful presence as something they were powerless to avert.

Fortunately, my arrival did not prevent the feast from coming off, as the Indians never allow anything to interfere with the proceedings of their ceremonies. A great event, the sacrifice of an ox, was to take place next morning, and the night preceding had to be devoted to singing, which began shortly after sunset. One man, a singing shaman, was the leader; and he related in song the mythical events of ancient times and the heroic deeds performed by the gods. Each stanza, as he sang it, was repeated by the multitude in front of him. I was astonished at the fertility of the Huichols in what we should call "legendary lore," but what to them is gospel truth and history. There are no written records kept of these traditions. They live on the lips of the people, as national heirlooms, passing from one generation to the next, as originally did the sagas and folk-songs of the ancient Northmen. If he had the physical endurance, a strong shaman could keep on singing new verses night after night for at least a fortnight. I also noted with admiration the quality of their voices. I have never, in any native tribe, heard such good singing.

The purpose of the song was to induce the gods to let the rain come down. The fervour of their efforts was not at all abated by the fact that torrents of rain were already falling before they started their ceremonies; their object now being to prevent the rain from stopping. My wishes were just as fervent in the opposite direction, as the rickety shed that had been assigned to me as my quarters was by no means waterproof. I became, however, reconciled to my fate

by the really beautiful singing of the leader. The steady downpour of the rain, punctuated by fitful flashes of lightning, formed a weird and fantastic accompaniment to the sympathetic singing that came to me through the pitchy darkness of the night, like a voice from fairyland. It was different from anything I had ever experienced among Mexican Indians, or elsewhere, and it seemed as novel as it was enchanting. From that day on I lived with the tribe for about a year.

Knowing that they hated all Mexicans, I discharged and sent back to their own country the men I had brought along with me. I was, therefore, now alone, "a stranger in a strange land"; and there being no hotel accommodations, I became a boarder in a Huichol family—the first and only one they have ever accepted. The conversation at meals was at first limited, as my host's knowledge of Spanish was confined to about a dozen words, and I had not yet learned any of the Huichol language.

While the people remained distrustful and disobliging, I was biding my time. I went to the many feasts that were being held in the temples, and by and by I learned a few stanzas of their songs; and as soon as they heard me sing these to them the situation became changed. They began to feel confidence in me, and to think that I might become of benefit to them. They considered it as something meritorious on my part that I could sing their songs; and the mere ability to mention the names of their gods in this way served me as a protection against any designs they may have had against me. I have even had occasion to utilize this knowledge among other tribes, who, while they did not understand the words, comprehended that the melody was of their own race, not a white man's, and any utterance of it struck a responsive chord in their hearts.

From that time on I was treated with something like friendly consideration, and was taken to all their sacred places, caves, etc. At my request they showed me everything, and, though sometimes reluctantly, would sell me anything I wanted for my collections. But to get correct explanations from these people regarding anything connected with their religion is the hardest part of an ethnologist's task—far more difficult than the collecting and buying of things. First of all, I had to find the proper man to interview, because the mass of the people are ignorant in comparison with the well-informed shamans. These (combining, as in ancient times, the office of priest with that of doctor) are, so to speak, the scientists of the tribe. The next difficulty to overcome was to get

them to answer my questions truthfully. They naturally suspect that some harm may come to them from divulging their secrets to a stranger, as such indiscretion may upset their relation to the gods. Therefore, often they only pretend to give information, while in reality they give you falsehoods and evasions. When, after three or four weeks' searching, I had managed to find the proper man, he generally turned out to be a sympathetic, kind-hearted individual, full of enthusiasm for his faith. But now a new difficulty presented itself in the fact that the brains of these people are so unused to any mental exertion that answering questions soon proved too much for them. It has happened that not only the shaman himself, but the several Indians I had to assist me in interpreting, would drop off to sleep. I had to let them go, because they were exhausted, tired out. After that it would require weeks or months before they would consent to submit to a similar ordeal.

Dealing with these people, therefore, requires an endless patience. But when one succeeds he feels amply repaid for his efforts. There is nothing quite so gratifying as to rescue from oblivion the old myths and traditions that have never been told to a white man before. The glimpse revealed to you of the first faltering steps of the human mind, of the first dawn of history, makes you forget all the hardships and privations you have to submit to in order to obtain it. As the tribe had never been studied before, and as it is not yet contaminated by civilization, I had cause to believe that my labours among them would become of considerable scientific value.

The Huichols are of medium height, well built, of a light chocolate-brown colour, and very healthy. It is rather interesting to note that their babies, before they learn to walk, crawl on all-fours, not on their knees and hands, as do white children. Fond as I am of the Mexican Indians, I am bound to state that they have two failings, which, however, they share with many civilized persons. They have a great inclination to appropriate little things that strike their fancy, although they have never stolen anything from me; and then they do not tell the truth unless it suits them. Highly impressionable and exceedingly emotional, they are easily moved to tears or laughter. They are not warlike, and, if it is necessary to kill an enemy, they prefer to assassinate him.

Their daily life passes much in the same rounds as that of other Indians. The women spend most of their time grinding corn on the metate, and the men make arrows and bows, which are still the only weapons they use in the chase. They also make a weak native

brandy from the root of the maguey, and their distillery is of considerable interest.

The people live in houses generally circular, and at their ranchos there is always to be found a god-house for the worship of the local patron deity. The temples, of which there are about twenty, are built on the same plan as the houses, only much larger. In the centre of the temple floor there is always a place for the fire, which is kept up all night during the dances; but there are no idols here. These are kept in sacred caves in the mountains. Adjoining the temples there are always a number of god-houses, the inside of which presents a striking appearance, on account of the numerous ceremonial objects deposited to please the gods.

The agriculture of the Huichols is of the most primitive type, and consists in simply cutting down and burning the brushwood and then planting corn by digging holes in the ground with a stick, dropping some grains into each hole and closing the earth up again with the point of the foot. As there is little, if any, level land in their mountainous country, the people are obliged to plant on the slope of the hills, where most of the falling rain runs off without penetrating the soil. Therefore, almost incessant rain is needed in summer to make the crops grow. If it stops raining, even for only three or four days, the plants begin to be scorched by the heat of the sun.

As the Indian is thoroughly materialistic, and directs his entire thought towards procuring sufficient food, it will be understood how rain has become the main object of his prayers and the pivot on which his entire religion revolves. His fundamental belief is that the gods are all around him along the horizon, listening to what he says and watching what he is doing. They are angry with man, and grudge him everything; therefore, they also keep the clouds to themselves. But the shamans know how to propitiate them—to put them, so to speak, in good humour by singing of their great deeds in ancient times. The song pleases the gods, and then they let go the clouds. Thus the shamans, and indirectly the people themselves, are able to make it rain.

In addition to the singing it is imperative to make sacrifices of oxen, corn, and whatever else they may have; to hunt deer and to kill turkeys. The Huichol is devoutly religious, and his entire life is one endless devotion to his gods. From his birth to his death his actions are governed by the belief in his native deities, all his thoughts being ever directed toward pleasing them. On

important occasions he takes the advice of the shaman, who throughout his life stands by him in all his troubles, mental and physical.

Many feasts are held during the year—some to prevail upon the gods to bestow upon the people bountiful crops and similar benefits, others to thank them at harvest-time.

Of the greatest importance in the life of the Huichol is the cult of a small cactus, called by them *Hikuli*. This plant has become known to science only in late years, and is of considerable interest. When eaten it creates colour visions; more than that, it takes away all feeling of hunger, thirst, or fatigue, however intense these sensations may have been. Although it has a most exhilarating effect, the condition produced is altogether unlike that following the use of alcohol. The equilibrium of the body is kept better than normal, and a man is enabled to walk steadily and fearlessly along a precipice which otherwise would make him dizzy.

To obtain this plant the Huichols have to send each year deputations to the high central plateau of Mexico, the home of this cactus. The Hikuli-seekers have their faces painted with the colour of fire, and are equipped with plenty of plumes and tobacco-gourds. Something like six weeks are required for this pilgrimage. Considering the difficulties that must have beset these journeys in ancient times, when the lands of hostile tribes had to be crossed and recrossed, they are an eloquent testimony to the strength and fortitude which religious conviction will impart even to a barbarian soul. Not less than four months are spent in preparations for the feast celebrating the arrival of the fresh Hikuli. These preparations consist principally of prayers for success in hunting deer, as without the deer being killed the feast cannot come off. So prominent a part does the deer play in the religion of the Huichols that if by any chance this animal should become extinct the religion of the people would have to become modified.

The gods are, in the main, personifications of natural phenomena, as the sun, fire, water, and air. They are called Fathers, Grandfathers, Great-Grandfathers, and Elder Brothers, while the goddesses are Mothers. The main goddess, the mother of all the gods and of vegetation, is called Mother Nakawé, and resides in the nether world. There are a great many Mothers, chief among them those of corn, water, springs, and rain.

The Huichols also look upon their gods as the founders and ancestors of the tribe, the originators of the customs of the people, and the inaugurators of their religious ceremonies. Further, they believe that the gods even taught the tribe how to worship

them, in their own peculiar way. The Huichols, like the Aztecs, believe that they themselves made the Sun.

In the beginning, the Huichols will tell you, there was only the light of the moon in the world, and the people were much inconvenienced. The principal men came together to consult what should be done to give the world a better light. They asked the moon to lend them her only son, a limp and one-eyed boy. She at first objected, but at last consented. They gave the boy a full ceremonial dress, with sandals, plumes and tobacco-gourds, and his bow and arrows, and they painted his face. They then threw him into an oven, where he was consumed; but he revived, ran under the earth, and five days later arose as the Sun.

When the Sun radiated his light and heat over the world, all the nocturnal animals—the jaguars, the mountain lions, the wolves, the coyotes, the grey foxes, and the serpents—became very angry and shot arrows at him. His heat was great, and his glaring rays blinded the nocturnal animals ; and with eyes closed they retired into caves, water-pools, and trees. Still, if it had not been for the grey squirrel and the gigantic woodpecker, the Sun would not have been able to complete his first journey across the sky. These two were the only ones who defended him ; they would rather die than allow the Sun to be shot, and in the west they placed *tesvino* (a kind of beer) for him so that he could pass. The jaguar and the wolf killed the grey squirrel and the gigantic woodpecker, but to this day the Huichols offer sacrifices to these hero gods and call the squirrel father.

Not only is the entire territory of the Huichols full of sacred places, but also the land through which the Hikuli-seekers travel. In addition to these holy places, the people erect a number of god-houses, next to the temples, and also in lonely places in the forests. The most important of all the sacred localities is Teakata, where resides the most ancient idol, the God of Fire, besides a number of other deities.

The intense religious feeling and the desire to retain the favour of the gods manifests itself in a number of symbolic objects, which serve as embodiments of prayers and expressions of adoration.

As may be expected from beings whose life moves in such a narrow horizon, the symbolic objects are mainly those of their daily life; though some, like the shields, are no longer in practical use. They comprise, first of all, the paraphernalia of the warrior of ancient times: his front shield, his back shield, and his arrows.

The last, on account of their prime importance, we will consider first.

There is no problem in ethnology so difficult to solve as the meaning of the arrow in its different applications. It has a personal significance, and a relation to the clans into which the tribe is divided; and obliging though the Huichols were to me, they shrank from exposing so personal a matter. I have, however, succeeded in lifting a little of the veil of mystery that overhangs the arrow.

It is generally conceded that the arrow must be viewed as a bird with the neck outstretched, and the mystic power of the bird, which soars high and sees everything, is also attributed to the arrow. As the heart of the bird is between the wings, so the vital part or heart of the arrow is thought to be in that portion to which invariably feathers are attached, the so-called winged part. On this are painted symbolic decorations, consisting generally of longitudinal lines to indicate the path of the arrow, and zigzag lines to suggest its speed and strength.

Even primitive man has some idea of evolution and the struggle of mankind towards perfection. Therefore, we find in the Huichol myths that originally the arrows of the gods were made of a kind of stiff, coarse grass resembling bamboo, but lacking its strength. These arrows were too fragile, and the gods could kill rabbits with them, but not deer. They smeared rabbit blood on their arrows, yet that kind of blood was not very effective, and the arrows remained weak and ugly. The gods succeeded by and by in killing a doe; and after smearing that kind of blood on the arrows, the latter at once became strong and powerful, so that the gods could now go to hunt deer.

The arrow is a synonym for power, especially that of the gods. Thus the rattlesnake, the scorpion, and even the meteors, are arrows of certain gods.

Aside from the arrows used in the chase, there is another and very important kind, which is used solely as sacrifice to gain favour from the gods. In appearance this ceremonial arrow is much like the bow-arrow; but, as a rule, the rear shaft is more extensively decorated. What these decorations mean in each case is still largely a mystery. But this much is certain: that in a sense they are symbolic of the god to whom the arrow is dedicated; his coat-of-arms, or monogram, so to speak. On some arrows these markings are rather complicated, the decorations being divided into several fields, each having its own meaning. One may express the face of the god, another his wristlet; a red one may stand for the

blood of the deer, a green one for Hikuli, etc. Plumes, which are invariably attached to the arrow to speed it on its flight to the god, are always selected from a bird belonging to the special god to whom the arrow is addressed; for instance, the principal god, Grandfather Fire, has the royal eagle and the macaw—the latter on account of its brilliant fiery plumage.

The most common way to sacrifice an arrow is to stick it upright in the ground. Thus arrows may be found in all sacred localities; in springs and lagoons, in deep crevices between rocks, on the mountains, on the shore of the Pacific Ocean, wherever some god may dwell whom the imaginative Huichol desires to implore or to appease. For the arrow stands for him personally, or for the tribe, praying its silent prayer. "It talks alone," says the devout Huichol, meaning that it does not need the aid of the shaman.

More than anything else the Huichol uses the arrow to express his prayers and his adoration, and it is inseparably connected with his life. When preparing for any event of importance, he makes an arrow, thereby asking protection or favour from the gods. When a child is to be born into the family, the father's first duty is to make an arrow, and he continues to make arrows every five years for each of his offspring, until the boys are old enough to make their own arrows, or until the girls marry, when the husband assumes this responsibility. When the Huichol wants to hunt deer, or till the soil, or build a house, or marry, he has to make an arrow to insure success. In case of sickness, arrows have to be made to restore the patient to health; and when he dies, an arrow is stuck in the house, that the dead may not come back to disturb the survivors. Thus, from the cradle to the grave, in all conditions of life, arrows are made to smooth man's road as he journeys through life. Besides, in making arrows a man gains knowledge of all sacred things.

Not only are the arrows sacrificed by themselves, but they are also used as carriers of special prayers. The Huichol ties to them small front shields, back shields or mats, diminutive tobacco-gourds, sandals, bows, and many other objects expressive of certain desires. The idea is, no doubt, that the prayer is thus shot to that god whose address is painted in the coloured designs on the rear shaft.

The Huichols of to-day do not use front shields, but the shields are spoken of in their legends and myths. They use ceremonial shields as emblems of prayers for protection against evil and re-

quests for favours. Most of them seem to be dedicated to the sun, who, to the Huichol, is a man, whose shield is visible every time he climbs above the horizon. These ceremonial shields are made from split bamboo reeds, interwoven with variously-coloured crewel, so as to form a flat disk. Sometimes the traditional hole is left in the centre, but often it is only indicated in the weaving. The smallest shields may be only three inches in diameter; but there are also many which measure from twenty to twenty-five inches. What they lack in substantiality they generally make up in artistic merit, and the effect produced is frequently astonishing, considering the material at the command of the maker. Mythological, cosmic, and other ideas, all expressive of prayers, are woven into the shield and form the design.

It was a contemplation of these shields, hung up in a row, which caused my friend Mr. Cushing to suggest that the symbolism depicted on them makes it highly probable that these shields are related to the dance shields of the ancient Mayas. He thought that if these shields were hung up in the temples in some orderly array they would soon come to be considered as "speaking-shields," or an attempt to record events or deeds in visible form, and the next step would be to carve them on the walls as they are seen to-day.

Very different from the front shields are the back shields, which are also considered as mats or beds. Some of them are made of the same materials as the front shields; are rectangular in shape and present designs almost as beautiful. In conformity with the original idea of the back shield, as a protector against the fierce rays of the sun and the arrows of the enemy, the back shields have become very important media for prayers asking protection against evil. It is not uncommon to see depicted on them a mountain lion, which expresses a prayer that the god may protect the cattle against this ferocious animal. The Cora Indians complained to me that the Huichol tried to keep the clouds from reaching the Cora country by placing small back shields with designs of ferocious beasts in the roads, in order to frighten the clouds back and prevent them from leaving the Huichol territory.

There are also several other shapes in which back shields are made. Sometimes they are square and made by tying together splints of bamboo. Very often they are simply scraps of textiles woven for the purpose. In some cases back shields are made of grass. The grass is supposed to be the bed of one goddess, and the flowers that of another; therefore, these mats are prayers for rain, as neither

grass nor flowers grow during the dry season, but need the rain to blossom forth. But the idea connected with all the back shields is that the gods and goddesses are sleeping on them; hence the prayers embodied in the designs are in this way thought to be brought more efficaciously to the notice of the deities, who must see them when they are going to bed. Many prayers, for instance those for luck in handiwork, are expressed by back shields.

Another symbolic object of very great interest is the god's eye, called Sikuli, the idea being that it may rest on the supplicant and give him health and life. It consists, roughly speaking, in a diamond-shaped figure produced by interweaving the arms of a small cross with variously-coloured crewel. The *eye* is supposed to represent the flower of the squash; and at the feast of green corn and squashes these objects are attached to the heads of the children to insure their health. *God's eyes* are found in great profusion in the ancient burial-places in Peru, and in some cases they have been fastened to the false heads of mummies, serving actually as their eyes. This is a striking illustration of the wide distribution of some of the native ideas, as the same symbolic object is used by a multitude of tribes along the Pacific coast. It also demonstrates how the study of one American tribe may shed light upon the problems presented by another, though the latter be far removed from the former in time and space.

Finally, I will mention that votive bowls are also largely used as sacrifices and prayers. They are the ordinary drinking bowls of the Huichols,but much adorned with beads, which are fastened by means of beeswax, and form symbolic designs expressive of the desires of the giver. The idea which actuates this sacrifice is that the gods, when coming to use their bowls, will drink in the prayers of the people.

With the primitive implements and crude methods of the Huichols it is but natural that the products of this devotional industry should not be of a lasting nature. This is one reason why the ceremonial objects lose their power after five years and have to be renewed. Outside of each god-house are heaps of discarded ceremonial objects, from which an ethnologist may add to his collections. The people are kept busy making these curious objects, especially before each feast, when all the officers of the temple may be seen sitting around engaged in their manufacture. To the uninitiated it looks more like a toy factory than the solemn and prayerful preparation for a great ceremony of a pious and devout people.

In extreme cases, when rain is badly needed, the Huichols will deposit what we may call an *ark*, in imitation of the boat in which the first Huichol rescued himself, when (according to their tradition) a flood drowned everything living on earth. This *ark* is deposited in a lake a week's journey south of the Huichol country, the idea being that what was once associated with water may again bring about the same effect.

Still more ingenious is the manner in which they try to attract the clouds by exchanging water between East and West. They carry a quantity of water from a sacred spring located two hundred miles east in the Hikuli country, and throw it into the Pacific Ocean, replenishing the spring by an equal quantity of water from the sea. In that way they think they make clouds pass over their country, because the water would feel strange in its new surroundings, and would want to return to the place it was taken from. As it has no other way of travelling than by rising in the shape of clouds, the two clouds have to pass over the Huichol country, where they meet and, bursting against each other, fall down as rain.

A constant diversity of meaning is naturally attached to the Huichol symbols. Thus, a pair of sandals of ancient pattern which are worn only by the shamans at their greatest feast have, in diminutive size, become a synonym for a prayer that the feast may come off; also a prayer that no harm may happen to the shaman at the feast. And, inasmuch as the feast cannot be celebrated unless a deer has been killed, a pair of such sandals also expresses a prayer for luck in killing deer. Finally, as in olden times only the men wore sandals, they may further express a woman's prayer to get a husband. But, despite the diversity of meanings attached to most symbolic objects, we can always trace a connection between the object and the symbolic meaning expressed by it.

In a few words I will now touch upon the conventionalism of the designs and patterns with which they decorate their clothing and household utensils.

It is erroneous to suppose that an Indian simply sits down and draws from his imagination when working out his often beautiful designs. No. Everything in primitive art has a meaning. The designs utilized are generally reproductions of animals, flowers, and household implements. But in time they have become so conventionalized that in most cases, owing to the innate artistic sense of the people, they can no longer be recognized by any one unfamiliar with them. Even the Indians themselves do not always know their

meaning, and I got my best information from intelligent old women. Often I was not a little surprised at the ingenuity manifested in their technique. The designs are, so to speak, permanent talking prayers for protection against evil, requests for some benefit, or expressions of adoration.

The people sometimes adorn themselves with the corolla of a certain little white flower, called *toto*, fastening it to their cheeks with saliva. As this flower grows only during the wet season, it is symbolic of rain and corn. It is extensively used as a *motif* in their weaving and embroidering.

From the symbolism of the Huichols it must be inferred that the main consideration of all their prayers is food—corn, beans, and squashes. The means of procuring good crops is rain; therefore, the majority of all their prayers ask first for rain, and then for food, health, life, and luck.

The most striking feature of the world, as the Huichol looks upon it, is the prevalence of serpents. In all ages, and in most of the primitive religions, serpents have been of primary importance. In India the earth was called "the Serpent Queen"; in Greece, a serpent biting its tail was the symbol of eternity; in the northern and several other mythologies, the sea surrounding the world was thought to be a serpent encircling it. The serpent, by shedding its skin, rejuvenates itself, and thus becomes the symbol of health and strength. As it is the only animal that moves on the ground without legs, it is considered particularly cunning. Its great skill is further manifested in the beautiful markings on its back; and when the Huichol woman wants to weave or embroider anything, she passes her hand over the back of a live serpent held up by her husband, that she may thereby gain ability to do beautiful work. As in olden times the serpents were considered good guardians of treasures, so to-day the Indians leave their fields to be guarded by serpents. The Huichols believe that most of their gods and all their goddesses are serpents, and even the pools of water and the springs in which the deities live. In the sky, in the wind sweeping through the grass, the moving sea, the sinuously-flowing rivers, the darting lightning, the descending rain, in fire, smoke, clouds—in fact, in all natural phenomena—these Indians see serpents. Maize, the plant itself as well as the ears of corn, the bow with its elastic reaction, the piercing arrow, and even the tobacco-gourds—all are considered as serpents. It may be added that they see snakes even in their own flowing hair, in the girdles around their waists, in the ribbons

streaming from their heads and pouches, in their wristlets and anklets.

The sacrifices, symbolic and otherwise, that I have tried to describe may not seem very valuable from one point of view; often they are mere trifles. But it should be remembered that the Indians are poor indeed, and have not much to give away, and that the making of the things implies a considerable expenditure of time and labour. The Mexican Indian never gives nor expects anything for nothing; therefore, he has to pay the gods for everything he asks from them; and he gives according to his means, knowing that "only a knave gives more than he has." To us his efforts are of intense interest, as they reveal the first faltering steps of the human mind towards expressing thoughts in visible form when first dawned the possibilities of that art which has become the most fundamental and the most powerful—the art of writing.

Advancing civilization has as yet scarcely touched the Huichol country. Once a year a priest visits one or the other of their villages for a week or two, to baptize or to marry those who desire it; and he meets with no opposition as long as he does not interfere with the native religion. This is the case not only with the Huichols, but with all the Indians. They gladly accept Christianity, because, in their opinion, the more religion they have the better for them, as they are so much surer of getting what they always pray for—rain. But never will they give up their ancient beliefs as long as they have their land. When their country is taken away from them, when they become homeless and the servants of the white man, they lose their self-respect, become demoralized and indolent, and form the poor class of Mexico, as may be seen in the suburbs of the City of Mexico, where the once proud Aztecs are now the proletarians of the place.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, January 20, 1903.

The Marine Hydrographic Service, the history of which from its foundation in 1720 to the present day was briefly sketched in my letter of May, 1902, preserved throughout the 19th century practically the same organization, with but slight modifications. At present, by the decree of the 25th of September, 1901, the Service is under the direct orders of the head of the Marine General Staff. The *personnel*, composed of hydrographical engineers, higher and subaltern officers of the navy, administrative functionaries and technical agents, is divided into seven sections: (1) *Service of General Hydrography;* (2) *Service of the French Coasts;* (3) *Service of Charts and Archives, and Tide Service;* (4) *Service of Nautical Instruction;* (5) *Service of Scientific Instruments;* (6) *Service of Nautical Instruments;* (7) *Service of Nautical Meteorology*. Four of these, together with the Bureau of Administration, the storehouse and the library, are under the orders of the Director of Hydrography; the 4th, 6th and 7th Services, at the head of which is a captain or a lieutenant, are immediately under the chief of the General Staff. All the work of the different services, as well as the questions proposed by the Minister, are examined by a Hydrographic Committee, composed of the Director, two superior naval officers, two chief engineers, and a secretary, and are presided over by an Admiral.

The General Hydrographic Service is charged with the construction and issue of charts and hydrographic plans of the coasts in all parts of the globe, with the exception of France, Algeria, and Tunisia. It supervises the work of engraving the new charts, and, after the proofs have been passed upon by the Hydrographic Committee, gives the final order for printing. It is by this body, also, that the existing charts are kept up to the level of the latest information received, and published either in new editions or with simple corrections on the plates and charts. The expeditions sent out to survey distant coasts receive their instructions from the same source.

These expeditions, but lately occupied in the successful exploration of foreign shores (Brazil, Newfoundland, Japan, etc.), are at present restricted to our colonies, the coasts of which were

insufficiently known. Hydrographical engineers direct the more important of these enterprises, such as that of Madagascar, which in 1889–1894 and since 1899 has charted the northwestern coast of the island from Cape Saint-André to Diego Suarez, and has made partial reconnaissances of the most important points on the western coast, south of Cape Saint André. Other expeditions, embracing no long extent of coast, are made by officers of naval divisions : such are, in Africa, the survey of the rivers of the French Congo and French Guinea and that of the gulf of Tajurra ; in Asia, the revision of the charts of the rivers in lower Cochin-China ; in Oceania, the survey of the Gambier Islands, that of Tubiai, and that of the most westerly group of the Tuamotu Islands.

The results of these different expeditions have already appeared, or will appear, in the charts, of which there are now published by the *Service* nearly 2650, in various styles and scales : charts covering an ocean or a sea, and showing the lines of navigation ; coasting and landing charts; charts of much-frequented coasts, where ports are numerous and ships keep close to the shore ; special plans of ports, of anchorages, of straits and difficult passages, full of perils. All these charts are constantly corrected and kept up with the changes brought about by the development of navigation, by the creation of new economical relations, by the work of man and by the incessant operations of nature. Many of these corrections necessitate the issue of new editions of charts ; those of a less considerable kind, such as the indication of an isolated danger or a change in a light or a buoy, are noted in special bulletins, and recorded on new issues of the charts.

The incidents of a geographical nature during the past two months have been few. Of these we may call attention to four addresses at the Conservatoire des Arts et Métiers on the subject of Oceanography. Two of these, by M. Julien Thoulet, were on the Science of Oceanography, one, by Dr. Portier, on Physiology and Microbiology, and one, by M. Joubin, discussed the Marine Fauna of the great depths.

In order to widen the public acquaintance with the vital questions relating to North Africa, the Administrations of Algeria and Tunisia have founded, at the Sorbonne and the Collége de France, two chairs, one consecrated to the Geography and the Colonisation of North Africa, the other to Mussulman Sociology and Sociography. The incumbents, MM. Augustin Bernard aud Le Châtelier, open their course with a study, each from his own point of view, of Morocco. Another chair, that of American Antiquities, recently

established in the Collége de France at the instance of the Duke de Loubat, is filled by M. Léon Lejeal, who has selected for this year's course the Examination of the Spanish sources of Pre-Columbian American History, and, with this, the study of various questions of Mexican archæology.

If we turn to the explorations now on foot, we find but little that is of interest. In Africa, Lieut. Guillo-Lohan, an officer of the Territory of the Saharan Oases, has made, to the south of In-Salah, and notably in the regions of the Hoggar, an excursion which may be expected to yield good results. The Anglo-French Commission to settle the limits between the Niger and the Chad begins with the reconnaissance of the regions traversed by the conventional frontier of 1898, and, particularly, the famous Sokoto arc of the circle. The Commission is also to seek for a practicable route of approach to Zinder, capital of the Third Military Territory, the map of which, recently drawn by Capt. Moll, will now be completed and rectified by him.

In Eastern Africa Viscount du Bourg de Bozas has continued the explorations of which we have previously written. A letter of September 9 brought information that the party had reached Lamule, at the confluence of the Nile with the Niama, about midway between Lado and the Albert Nyanza. The travellers made their way to the bank of the Nile from the southern edge of the Abyssinian plateau, passing along the valley of the Usne till it joined the Omo, and then following this river and exploring the northern coast of Lake Rudolf, and then through the unknown country of the Turkwanas. They mapped their route with great care by astronomical observations, and made important collections in ethnography and natural history. M. Du Bourg de Bozas hoped to cross the Congo Free State and terminate his journey in the French Congo. No other French expedition of similar importance has been made in recent years; but we must not overlook the travels of Count Lesdain, of the Legation at Peking, in Mongolia, in June-September, 1902, through an arid and mountainous region and over the vast plains to the north of the Hwang-Ho, transformed by the periodical floods of the river into a lake in which the villages form so many islets.

Some excellent works call for attention, in the general sterility of scientific publications in the holiday season. The first is the Report to the Glacier Commission of the French Alpine Club on Variations of the French Glaciers in 1900–1901. The author of the Report, M. W. Kilian, confines himself to a careful account of

the glaciers of Dauphiné,* accompanied by sketches and photographs, and followed by an admirable Review of Glaciology, full of facts and complete references, by M. Charles Rabot, who takes up, in succession: (1) The works relating to the physical and geological phenomena; (2) The recent explorations accomplished in the various glacial regions of the globe and the interesting phenomena of which he has taken cognizance; (3) The observations on variations in the length of glaciers. This Review, which is, in its line, as valuable to workers as the same writer's Review of Limnology, needs but one thing to make it complete: an index of names of places.

Thanks to the perseverance and productive resources of M. E. A. Martel and his scholars *speleölogy* has really become a special branch of natural science. The recent labours of the intrepid explorer of caverns throw new light upon several controverted points. Particularly important in this respect is the study of the subterranean river of Trépail (Marne) which constitutes the 88th Bulletin of the *Services de la Carte Géologique de France.* M. Martel's reconnaissance of this river in 1902 furnishes exact information on the circulation of the water in the chalk and seems to complete the overthrow of two very tenacious theories: that of the sheets of water in the calcareous and chalk formations, and that of the determination of the line of subterranean water-courses by the caverns. The explorations of Messrs. Van den Broeck and Martel at Han-sur-Lesse establish the fact (contrary to the recent statements of M. E. Dupont) that the subterranean Lesse is a single current, with occasional overflows and diversions of freshets and that the unknown portion of the course of the famous Belgian stream barely exceeds two kilometres. A most absorbing paper, published by M. Martel in the *Bulletin de la Société d'Etudes des Hautes Alpes*, on the Chouruns † of the Devoluy, calls the attention of speleologists to a field of exploration as yet almost untouched. The *chouruns* are not all known, nor is the position of their openings identified on the map, and it is too soon to make an attempt at their topographical classification; but M. Martel gives precise information concerning the Chourun Martin, the deepest abyss in France and, indeed, the deepest natural abyss yet known—at least 310 metres (1017 feet) and perhaps more than 500 metres (1640 feet).

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* This Report is, therefore, less complete than the two articles by Prince Roland Bonaparte, published in 1891 and 1892 in the *Annuaire du Club Alpin Français* on the Periodical Variations in the French Glaciers previous to 1890.

† *Chourun* is a local expression signifying *cavern* or *abyss*, and designating, above all, cavities descending perpendicularly to a very great depth.

Not less interesting, for another portion of the Alps, is the Study on the Formation of the Relief in the Diois and the Eastern Baronnies by M. V. Paquier, in *La Géographie.* This memoir is the complement of the Geological Researches of the same author in the region indicated, and it shows that the southern Diois, with its clearly-defined synclinal areas, almost east and west, is the continuation towards the north of the Baronnies, to which, moreover, it is tributary.

The geography of regions outside of France is not overlooked. M. Emmanuel de Martonne, of the Faculté des Lettres de Rennes, publishes, under the title of an Essay in Geographical Monography on Wallachia, a very complete study, fortified by travel in various parts of the country, and treating with equal care and attention the anthropogeographical and the geophysical aspects of the subject. This conscientious work, creditable in every way to its author, is illustrated by maps, sketches, and engravings.

The articles on the Natural Divisions of Algeria by MM. A. Bernard and Emile Ficheur, in the recent numbers of the *Annales de Géographie*, may be said to trace the plan of detailed work, the execution of which, it is to be hoped, will be entered upon in no long time. M. Edmond Doutté has contributed to the Bulletin du Comité de l'Afrique Française a summary report on his third journey in Morocco. This paper contains valuable notices on the tribes of the Hoûz. With it may be mentioned Capt. Cauvet's notes on the Touareg to the south of In-Salah; Lieut. Requin's account of a reconnaissance of the Mouydir plateau, executed by the *chef d'escadron* Laperrine, May 16–June 18, 1902; and the first part of M. Georges Thomann's report of a journey from the Ivory Coast to the French Sudan. A complete statement of the latest geographical work done in Madagascar, from the pen of Gen. Gallieni, is published in *La Géographie*, where also will be found the story of M. J. B. Charcot's excursion to Jan Mayen in 1902.

In historical geography M. Gabriel Marcel has published a notice of the plan of Paris, called the *Plan de Bâle*, the work of Olivier Truchet, who was the engraver of the maps of France and of Picardy by Jean Jolivet. The first volume of an admirably illustrated work by Messrs. Alfred and Guillaume Grandidier embraces a collection of works on Madagascar, published between 1500 and 1613, in Portuguese, Dutch, English, French, German, Italian, Spanish and Latin, either complete or in extract.

HENRI FROIDEVAUX.

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BY GIFT.

From Cyrus C. Adams, New York:

All the Russias, by Henry Norman. New York, Charles Scribner's Sons, 1902. 8vo; Latest Maps of Eastern and Western Connecticut. Boston, G. H. Walker & Co., s. a., *sheets folded in covers,* 16mo; Atlas de Filipinas, por el P. José Algué, S. J. Washington, Government Printing Office, 1900. 4to.

From Harlan P. Beach, Author, New York:

A Geography and Atlas of Protestant Missions. New York, Student Volunteer Movement for Foreign Missions, 1901–1903. 8vo and atlas folio.

From Prof. W. M. Davis, Cambridge, Mass., Author:

The First Year-book of the National Society for the Scientific Study of Education; Part II., The Progress of Geography in the Schools. Chicago, 1902, pr. 8vo; The Terraces of the Westfield River, Massachusetts. *With plate.* [From the American Journal of Science, Vol. XIV., August, 1902]; Systematic Geography. [From the Proceedings of the American Philosophical Society, Vol. XLI., No. 170, 1902.]

From Ch. Delagrave, publisher, Paris:

Atlas de Géographie Générale: Afrique, Fasc. spécial de Cinq Feuilles. G. Niox. Paris, 1903.

From the Verein für Erdkunde zu Dresden:

F. von Bellingshausens Forschungsfahrten im Südlichen Eismeer 1819–1821. Aus Grund des russischen Originalwerks. Leipzig, 1902. 8vo.

From Oscar Herrmann, Author, New York:

Pirates and Piracy. With illustrations by Frederick Ehrlich, and an Introduction by Herman A. Heydt. New York, Stettiner Bros., 1902. 8vo.

From Wilh. Dr., Freih. v. Landau, Author, Leipzig:

Beiträge zur Altertumskunde des Orients: III. Leipzig, 1903. 8vo.

From Dr. Wm. G. W. Lewis:

CHARLEVOIX, P. DE (*Translated*). Journal of a Voyage to North America. Vol. 1. London, R. & J. Dodsley, 1761. 8vo.

From Carl Lumholtz, Author, New York:

Unknown Mexico. New York, Charles Scribner's Sons, 1902. 2 vols. 8vo.

From Jules Mees, Author, Ghent:

Histoire de la Découverte des Iles Açores et de l'origine de leur Dénomination d'Iles Flamandes. *Université de Gand: Recueil de Travaux publiés par la Faculté de Philosophie et Lettres, 27e Fasc. Gand, 1901.* 8vo.

From the New England Catholic Historical Society, Boston:

The Acadians of Madawaska, Maine, by Rev. Charles W. Collins. Boston, 1902. 8vo. *Publications of the Society, No. 3.*

From Francis H. Nichols, New York:

Ten Rubbings of Monuments and Inscriptions from the City of Sian, Shensi, China, including the Nestorian Tablet. *Sheets, mounted.*

From Pettingill & Co., Publishers, New York:

National Newspaper Directory and Gazetteer. Boston and N. Y. (1902). 8vo.

From A. A. Raven, New York:

New and Complete English Traveller, etc. London, Alex. Hogg. s. a. Folio.

From the Royal Geographical Society, London:

Map of the River Congo, with Memorandum: The Upper Congo as a Waterway. By the Rev. George Grenfell. *5 sheets, folded in case.* London, R. G. S. (Reprinted from "The Geographical Journal" for November, 1902.)

From F. C. Schrader, Author:

Geological Section of the Rocky Mountains in Northern Alaska. *Bulletin of the Geological Society of America, Vol. 13, pp. 233–252.* Rochester, 1902. 8vo.

From the Oficina Hidrográfica, Valparaiso, Chile:

Ensayo de una Bibliografia Histórica i Jeográfica de Chile, por Nicolas Anrique R. i L. Ignacio Silva A. Santiago de Chile, 1902. 8vo.

BOOK NOTICES.

The Relations of Geography and History, by Rev. H. B. George, M.A., Fellow of New College. Oxford, Clarendon Press. Small 8vo, 296 pp.

This is a welcome volume; for there has been little attempt to deal in a systematic way with the influence of geographic environment upon historical movements. In such essays as we have there is much loose assertion, made without proof of genuine causal relations. This author, at the outset, places a temperate estimate upon the effects of environment, and thus prepares us to consider seriously what he has to say.

The first eight chapters, nearly one-third of the volume, are given to an account of general principles, under such heads as frontiers, towns, nomenclature, sea power in peace and war, and geography in war. Under frontiers, natural boundaries such as mountain ranges, hill country, and rivers are treated, with considerable reference to defence and invasion. Town sites always have interest, in the great diversity and combinations of causal conditions, such as defensibility, depth of adjacent waters, and industrial possibilities. There is an interesting reference to Bristol, once the second city of England, and perhaps excelling even London in its shipping. Glasgow and Liverpool have left Bristol far in the rear, because the Avon does not offer easy access to large modern vessels.

History and geography are brought into close relation by nomenclature, and geographic nomenclature is well called "fossil history." Here is a little-worked field for geographers who have leanings toward history, and who can restrain themselves from vague philological speculation. Europe is usually cited as rich in examples of geographic nurseries; hence our author is out of the beaten track when he tells us that few natural boundaries in Europe are so definite as to require them to be political frontiers. The British Isles, the Spanish peninsula, Italy, and Scandinavia about conclude the list. One would think that the Grecian peninsula might be added. Easy havoc is made with Wordsworth's lines, in which he calls the mountains and the sea the natural homes of liberty. Mountain life is "compatible with the most backward civilization, with great capacity for tyrannizing over others." A

rather good case is made out from the Scottish Highlands and some of the cantons of Switzerland.

Environment does not produce, or at least does not insure, power on the sea, for the Spaniard had unsurpassed opportunities, but has never equalled Englishman, Dutchman, or even the French. Nor does race altogether determine who will love and follow the sea: the Boers certainly had maritime ancestors, but are now strangely averse to the ocean.

The rest of the volume is mainly devoted to the countries of Europe, in separate treatment, beginning with a general discussion of the Outlines of Europe. The chapter on the British Islands could hardly be other than good, for here many principles apply without question, and the writer is on his native soil. Absolutely primitive man has afforded no remains in Britain, but this was to be expected, for strong boats are required to cross waters as wide as the Straits of Dover, and such craft could only be fashioned by men who had made considerable progress in the arts. There is an excellent passage on the insularity of Britain, a condition, perhaps, more controlling than all other geographic considerations combined. The Norman invasion was successful largely because England was not united, and in a few generations Edward I, almost pure Norman by descent, was yet "English to the backbone." Military service, lasting a bare forty days, would not do for an island which had business of war on the mainland, and hence the crown grew in power at the expense of the nobility. There could be no sudden attacks, no disputes about doubtful boundaries, and there has been no real invasion since the Norman conquest.

Ireland is too small to form an independent nation, and is related to Britain by being on the outer side, instead of lying between it and the continent, where it might have been a bone of contention between Britain and the continental peoples. Holland, like Britain, is at the centre of the land hemisphere, and has exceptional maritime advantages; but she is not insular, whatever other reasons there may be for her inferiority to Great Britain. Within England, geographic conditions are now exercising an enormous influence in shifting the centre of population northward toward the country of coal and iron.

These must serve as samples of the interesting suggestions found everywhere in the volume. The single chapter of six pages on America is, of course, altogether inadequate. Any one who is familiar with the powerful influence of the Appalachian barrier in our history is surprised to read that, "When the white men, hav-

ing settled along the Atlantic coast, began to push their way westward they encountered no geographical obstacles." But this is a small fault in a scholarly and useful volume. A. P. B.

Mont Pelée and the Tragedy of Martinique, by Angelo Heilprin. 8vo, 335 pp., with map and many illustrations. J. B. Lippincott Company.

Professor Heilprin's reputation as an observer and writer would lead one to anticipate a vivid and authoritative presentation of the great catastrophe. This expectation is fulfilled in the volume before us. We have the story of three ascents of Pelée, and of some weeks spent in its neighbourhood, as well as the accounts of resident observers here reproduced. The author brings out very fully the alarming events of the days preceding the cataclysm of May 8, and makes the false security of the people seem incomprehensible. The warnings would certainly have been heeded but for the authority of a few trusted advisers.

Naturally, among the absorbing chapters are those describing "the last day of Saint Pierre" (V), the destruction of May 8 (III), and the author's third ascent, that of August 30, on the evening of which Morne Rouge was destroyed and a large additional region devastated (Battling with Pelée, Ch. XV). Chapter XII has deep interest in its story of the tragic end of the devoted Père Mary, faithful to his spiritual charge to the last. Chapter VIII draws a parallel between Pelée and Vesuvius, and places some interesting question marks upon the ordinary geological teaching about Vesuvius. The closing chapter reviews in a summary way the phenomena of the eruption. Perhaps the passage of greatest interest in this chapter gives the author's conclusions as to the origin and aiming of the fiery blast that destroyed Saint Pierre:

> A volume of steam with intense explosive energy rising to the crater-mouth, blowing out in its first paroxysm a part of the crater-floor, and then exploding in free air under a heavily-depressing cushion of ascending steam and ash, and with surrounding walls of rock on three sides and more to form an inner casing to nature's giant mortar. The blast was forced through the open cut, or lower lip of the crater, that was directed to Saint Pierre.

A. P. B.

The Hudson River, from Ocean to Source, by Edgar Mayhew Bacon, with 100 illustrations, and with sectional map of the Hudson River. 590 pp. G. P. Putnam's Sons.

This volume is uniform in appearance and in general character with Reid's Mohawk Valley, issued from the same press one year earlier. It is described upon the title page in the words Historical—

Legendary—Picturesque—on the whole a truthful designation While professing to deal with the entire river, more of the chapters are given to the lower Hudson, with its ample history. The work is geographical in a secondary sense only, but places events in their scenic settings effectively. A rather scanty chapter of twenty-two pages is devoted to the river above tide-water. The first chapters give many good pictures of the first settlements, the manners, pageants, and social gatherings of old New York. Then come gossippy stories of Fulton's steamboat, and the "Passing of the White Wings," and of the "Land of Irving and the Literary Associations of the Hudson," recalling not only Irving, but Halleck, Hoffman, Drake, Willis, Beecher, Burroughs, Downing the landscape architect, and many others. The military movements of the Highlands are not neglected, and, altogether, the Dutch, the English, town, forest, mountain, and river are placed before us with a ready pen, and suitably to the reader who would have real history and real geography, but would not care to take either too seriously. The illustrations are in part from photographs, and in many cases from old engravings, and both sorts are, as a rule, equally good.

A. P. B.

The Romance of the Colorado River, by Frederick S. Dellenbaugh. 8vo, 399 pp. G. P. Putnam's Sons.

This volume, as its title implies, is a popular rather than scientific description of the great river. But the author shows himself familiar with the classical writings of Powell, Dutton, and Gilbert, and has a first-hand knowledge of the stream and its cañons from much sojourning in the region, and particularly from being associated with Powell in the latter's second exploration of 1871 and 1872. The work is more than a compilation, therefore, though it owes much to the report of Ives, and to Powell's brilliant narrative of the uniquely successful running of the cañon in 1869. The illustrations are abundant, being about two hundred in number, largely from photographs, ranging in locality from Wyoming to the Gulf of California. The early Spanish explorers, the missionary Fathers and the trappers occupy the early chapters, and then come Ashley, Hardy, Fremont, and others. Chapter VII is given to Ives, and the next two are devoted to the "One-armed Knight" and his voyage of 1869. Powell's second expedition is treated more in detail, as is natural, from the author's connection with it. The last chapter includes the story of Brown's unfortunate expedition. An epilogue contains a sympathetic sketch and a good portrait of Major

Powell, whose name will always be linked with this strange river and its unrivalled cañon. The appendix gives a somewhat detailed profile from the Wind River Mountains to the Gulf of California.

A. P. B.

F. von Bellingshausens Forschungsfahrten im Südlichen Eismeer, 1819-1821. Auf Grund des russischen Originalwerks herausgegeben vom Verein für Erdkunde zu Dresden. Leipzig, S. Hirzel. 1902. pp. 204.

In 1831 the Russian explorer Bellingshausen published in St. Petersburg, in two quarto volumes, his account of the two important voyages he had made into the Antarctic regions. His routes have long been depicted on all the best maps of the South Polar waters, but his narrative has had very few readers outside of Russia, for it has never been translated into any other language. The largest results of his work have been well summarized by Dr. Karl Fricker and some other writers, but many valuable features of Bellingshausen's researches, particularly in the domain of physical science, have not been accessible to most scientific men.

The explorer's book, however, was so voluminous that the Dresden Geographical Society decided not to assume the expense of publishing a translation of the entire work, which had been prepared by Professor H. Gravelius, and which, if published, would have been more than three times as long as the condensation by Professor Gravelius, which has now appeared.

This gives a literal translation, as far as possible, of Bellingshausen's book in all matters of larger scientific interest, such as the determination of geographical positions, meteorological and physical observations, etc. Professor Gravelius has suppressed or subordinated the descriptive features of the narrative, such as Bellingshausen's sketches of his visits to various ports and islands and other of the lighter features of the book. It is scarcely necessary to say that the German version of Bellingshausen is, therefore, better adapted for scientific readers than for the general public. With the revival of research in the Antarctic regions this reproduction in a language widely known of the most valuable parts of Bellingshausen's work is very timely.

The Uganda Protectorate. An attempt to give some description of the Physical Geography, Botany, Zoology, Anthropology, Languages, and History of the Territories under British Protection in East Central Africa between the Congo Free State and the Rift Valley, and between the First Degree of South Latitude and the Fifth

Degree of North Latitude. By Sir Harry Johnston, G.C.M.G., K.C.B., etc. In 2 vols. 506 illustrations from drawings and photographs, 48 full-page coloured plates and 9 maps. Hutchinson & Co., London, 1902.

Uganda has attracted more attention since the narratives of Speke, Grant, and Stanley first appeared than any other part of tropical Africa, excepting the Congo Free State, partly because its native government was interesting, as being the most powerful and compact political organization in equatorial Africa, and also because the European teachers living in Uganda have been more successful than in any other part of the continent in establishing schools, churches, hospitals, and the printing press. Many books have been written about Uganda, but Sir Harry Johnston's very long work of 1,018 pages, devoted to the whole area embraced within the Uganda Protectorate, gives an amount of description and information that is scarcely to be found in any other work on Africa. Little or none of the book is given to the details of travel, but, on the contrary, it is all a record of observation and study relating to many aspects of the country and its people, and largely of a scientific character. It is one of the best outcomes yet observed of the new phase of African exploration—the era of detailed and minute study in comparatively small fields, which has succeeded the days of pioneer discovery and of routes traced across the continent.

Natural history has a very prominent place in the work, as in every book that the author has written ; but the whole is an encyclopædia of information on an unusually interesting part of Africa. The hundreds of illustrations of landscapes, people, and animal life are illuminative, and the nine maps are produced in the superior manner of the Bartholomew map house of Edinburgh. They include political and orographical maps of the Protectorate and others, showing the density of native population and the distribution of rainfall, navigable waterways, vegetation, native races, language groups, and religions. The author takes a very hopeful view of the commercial prospects of the country, now that the Uganda Railroad connects the Victoria Nyanza with the Indian Ocean.

Complete Geographic Description of the Russian Empire. Prepared under the direction of P. N. Siemienov and V. I. Lamanski. Editor V. P. Siemienov. Vol. II. The Black Earth Region of Middle Russia. Devrien, St. Petersburg, 1902. (In Russian.)

This large work on Russia undertaken by Mr. Devrien is pro-

gressing. The newly-published volume is devoted to the Black Earth region, including the provinces of Ryazan, Tula, Orlov, Tambov, Penza, Voronezh, and Kursk. The book describes the topography, geological formation, rivers, soils, climate, fauna, and other features. Particularly detailed descriptions are given of the more densely-peopled regions in the order of their distribution along the railroad lines or tributary to them. The book has 123 illustrations, 35 diagrams, and one large and ten small maps.

On the Lakes of Southeastern Wisconsin. By N. M. Fenneman, Ph.D., Professor of Geology, University of Colorado. Pp. 178, Index, 36 plates of half-tone illustrations, 38 figures in the text and a small geological map of Wisconsin. (*No. VIII. of the Wisconsin Geological and Natural History Survey, Educational Series, No.* 2.) *Madison, Wis., 1902.*

This well-written and interesting volume is devoted to the physical geography of the lakes of Wisconsin, and is specially intended to assist teachers in the southeast part of the State to use the natural features of that region as an aid to understanding the principles of physical geography and geology. Teachers and students who may visit these beautiful lakes for purposes of physiographical study are to be congratulated upon having so helpful a guide.

NOTES AND NEWS.

The Next Meeting of the Society will be held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, the 17th of March, 1903, at 8.30 o'clock P.M.

Mr. Harry de Windt will address the Society on the incidents of a journey From Paris to New York by Land.

On the 14th of April Mr. E. L. Corthell will recount his observations and experiences during Two Years in Argentina as Consulting Engineer of the Ministry of Public Works.

Prof. E. L. Stevenson's paper on Martin Waldseemüller and the Earliest Cartography of the New World (announced for the 17th of February and postponed on account of a snowstorm) will be read before the Society in November.

The Peary steamer *Windward*, presented five years ago to Mr.

Peary by Mr. Alfred C. Harmsworth, of London, was sold in February to Capt. Bernhard Jensen, of Christiania, Norway. Built at Peterhead, Scotland, about forty years ago for the whale fishery, the *Windward* has passed three winters in the Arctic—the first in 1894–95, at Franz Josef Land, whence, after landing the Jackson-Harmsworth party, she was unable to extricate herself; the second, at Allman Bay, seventy miles north of Cape Sabine, on the eastern coast of Grinnell Land, as Commander Peary's headquarters during the winter of 1898–9; and the third at Payer Harbour, near Cape Sabine, with Mrs. Peary and Miss Peary on board, in the winter of 1900–01, where Commander Peary came on board May 6, 1901, on his journey southward from Fort Conger. The *Windward* has twice been thoroughly repaired by the Peary Arctic Club, new engines of high power, giving her more than double the former speed, having been installed at the Newburgh (N. Y.) works of T. C. Marvel & Co., last summer.

Capt. Jensen, Commander of the *Antarctic* and Sir George Newnes' *Southern Cross*, in their voyages to the South polar zone, will transfer the *Windward* to a corporation to carry on whaling under the Russian flag, in East Asiatic waters. Thence she will proceed by way of Kerguelen Island for sea lions and seal to be sold at Melbourne, Australia, in February of next year, and be associated with the *Rex*, which made a successful cruise last year in waters found profitable by the Japanese. The *Windward* will be fitted for her new work at Christiania.

A series of observations has been made by the United States Geological Survey on certain streams in the Catskill region and lower Hudson Valley, which are being studied in connection with possible future use for the supply of New York City. The results of the investigation are published in No. 76 of the series of Water-Supply and Irrigation Papers.

One of the objects of hydrographic engineers in measuring the flow of streams has been to determine the line of mean velocity of the flowing water. Through experiments on the Catskill, Esopus, Rondout, and Fishkill creeks and on the Wallkill and Housatonic Rivers it has been ascertained that the mean velocity for small vertical sections 5 to 10 feet in width is found at or very near a point six-tenths the depth of the stream.

The same investigations were carried on when these streams were frozen over, and it was noted that the ice-covering had the effect of making two points of mean velocity in any given vertical

section—namely, at approximately 0.13 and 0.73 of the total depth measured from the bottom of the ice.

In addition to these studies, observations were made to determine the amount of turbidity, colour, alkalinity, and hardness of the waters of these streams under the varying conditions of high and low stages.

TRANSACTIONS OF THE SOCIETY.

JANUARY–FEBRUARY, 1903.

The Annual Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, January 27, 1903, at 8.30 o'clock P.M.

Vice-President Moore in the chair.

The following persons, recommended by the Council, were elected Fellows:

William Redmond Peters, John R. Gibney, Edward D. Adams.

The Annual Report of the Council was then submitted and read:

NEW YORK, January 8, 1903.

To the American Geographical Society:

The Council respectfully submit the following report for the year 1902:

The number of Fellows on the 1st of January was 1,206. The additions during the year number 85. The losses by death, resignation, etc., were 93, and the total Fellowship on the 31st of December was 1,198, of which number 345 were Life Fellows.

The additions to the Library number 3,673: Periodicals and Pamphlets, 2,618; Books, 734; Maps and Charts, 298, and Atlases, 23.

Six meetings of the Society were held in the year:

On the 21st of January Mr. Alden Sampson described his visit to Palmyra;

On the 18th of February Mr. Richard E. Dodge read a paper on Life Conditions in a Desert, with special reference to the Southwestern United States;

On the 18th of March M. Hugues Le Roux described in French a Visit to the Emperor Menelik;

On the 15th of April Mr. Carl Lumholtz read a paper on the Huichol Indians of Mexico;

On the 18th of November Civil Engineer R. E. Peary addressed the Society on the work of the Peary Arctic Club in the Arctic, 1898–1902;

On the 23d of December Mr. George S. Morison addressed the Society on the Panama Canal.

There have been published in the BULLETIN, besides the Record and Scientific Notes and Letters, Seventeen original papers.

The house No. 11 West 29th St., for so many years the home of the Society, has been sold for $75,000.

For the condition of the finances reference is respectfully made to the report of the Treasurer, herewith presented.

The receipts, other than ordinary, have been as follows :

Legacies : from the Estate of Charles P. Daly	$16,877.83
" " " " S. F. B. Morse	1,000.
Donations	11,786.37

The legacy of $1,000 from the Estate of Mr. S. F. B. Morse is to be appropriated, according to the provisions of his Will,

> "towards the procuring of a suitable medal for the encouragement of geographical research."

The Will of Mr. Morse was made in 1872. In the present condition of the money market this sum will not produce an income sufficient to pay for a medal worthy of the name of Mr. Morse or likely to be acceptable to geographers of distinction. Therefore it has been decided to invest the amount at compound interest until the fund shall increase to a sum sufficient to produce an income adequate to carry out the designs of Mr. Morse.

Respectfully submitted,

HENRY PARISH,
Chairman.

LEVI HOLBROOK,
Secretary.

The Report of the Treasurer was then read:

The Treasurer respectfully reports that on January 1st there was on hand a cash balance of		$10,460.35
During the year there have been received for Fellowship Dues, Sales of Publications and interest on investments		16,707.79
Legacies and Donations		31,642.77
Proceeds of sale of No. 110 West 29th St.	$75,000.00	
Less remaining on mortgage at 4%	50,000.00	25,000.00
		$83,810.91
There has been expended for Salaries, Library, Meetings, Publications, House expenses, Insurance, Postages, Furnishings, &c	$16,393.21	
On account of New Building	6,791.12	
Invested	53,500.00	
		76,684.33
On December 31st cash balance in Bank		7,126.58

The Committee charged with the duty of selecting candidates for the offices to be filled made the following Report:

NEW YORK, January 8, 1903.

To the Council of the American Geographical Society :

The Committee appointed to recommend to the Society suitable persons to be elected in January, 1903, to fill vacancies then existing in its offices respectfully

report that they recommend the election of the following-named persons to the offices below designated :

President—ROBERT E. PEARY.
Vice-President—W. H. H. MOORE.
Foreign Corresponding Secretary—WILLIAM LIBBEY.
Treasurer—WALTER R. T. JONES.
Councillors—FRANCIS M. BACON,
JOHN GREENOUGH,
JAMES J. HIGGINSON,
S. NICHOLSON KANE,
M. TAYLOR PYNE.

FRANCIS M. BACON,
JOHN GREENOUGH,
CHANDLER ROBBINS, } *Committee.*

On motion, duly seconded, Mr. Cyrus C. Adams was authorized to cast the vote of the Society for the candidates, and they were declared duly elected.

Mr. William Libbey then addressed the Society on his recent visit to the Jordan Valley and Petra.

On motion, the Society adjourned.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, February 17th, 1902, at 8.30 o'clock P.M.

President Peary in the chair.

The following persons, recommended by the Council, were elected Fellows:

Otto Gerdau. Rufus H. Wood.
William Sellers. Frederick Strauss.
Henry R. Wood. William H. Wallace.
Henry R. Taylor.

The President explained to the Society that the very heavy fall of snow had prevented the arrival of the apparatus for illustrating the lecture announced for the evening, and introduced Prof. E. L. Stevenson, who gave a summary of his address on Martin Waldseemüller and the Earliest Cartography of the New World.

On motion, the Society adjourned.

THE

AMERICAN GEOGRAPHICAL SOCIETY OF NEW YORK

Council

Councillors

Candidates for admission into the Society must be proposed and seconded by Fellows.

There is no admission fee. The initial payment and dues of a Fellow for the first year are $10; and the dues $10 yearly thereafter, payable in advance on the 1st of January.

Life Fellowship, free from all dues, $100.

The privileges of a Fellow include admission to the Meetings of the Society and the use of the Library and Map-room, and entitle him also to a copy of all the Society's periodical publications issued during his Fellowship.

BULLETIN

OF THE

American Geographical Society.

Vol. XXXV **1903.** **No. 2**

SPIRITUAL BEINGS IN WEST AFRICA: THEIR CLASSES AND FUNCTIONS.*

BY

ROBERT HAMILL NASSAU.

Inequalities among the spirits themselves are so great that they indicate simply differentiations of character or work. So radical are these varieties, and so distinct the names applied to them, that I am compelled to recognize a distinction into classes.

1. *Inina*, or *Ilina*. A human embodied soul is spoken of and fully believed in by all the tribes. It is known in the Mpongwe tribes of the Gaboon country as *Inina* (plural, anina); in the adjacent Benga tribe, *Ilina* (plural, alina); in the great interior Fang tribes, *Nsisim.*

This animating soul, whether it be only one, or whether it appear as two or three or even four, is practically the same and the only one that talks, hears and feels, that sometimes goes out of the body in a dream, and that exists as a spirit after the death of the body. That it has its own especial materiality seems to be indicated by the fact that, in the Fang, Bakele, and other tribes, the same word, *nsisim*, means not only *soul*, but also *shadow.* The shadow of a tree, or any other inanimate object, and of the human body, as cast by the sun, is nsisim.

In my first explorations up the Ogowe River, in 1874, as my village preaching necessarily and constantly spoke of our soul—its sins, its capacity for suffering or happiness, and its relation to its divine Maker—I was often at a loss how to make my thoughtless audience understand or appreciate that the "nsisim" of which I was speaking was not the nsisim cast by the sun as a darkish line

* See BULLETIN No. 5, 1901.

on the ground near their bodies. Even to those who understood me it was not an impossible thought that that dark narrow belt on the ground was in some way a part of or a mode of manifestation of that other thing, the nsisim, which they admitted was the source of the body's animation. So far defined was that thought with some of them that they said it was a possible thing for a human being to have his nsisim stolen or otherwise lost and still exist in a diseased and dying state, in which case his body would not cast a shadow. The story of "The man without a shadow" in actuality.

2. *Ibambo* (Mpongwe plural, abambo). There are vague beings, "abambo," which may well be described by our word "ghosts." Where they come from is not certainly known, or what locality they inhabit, except that they belong to the world of spirits. Why they become visible is also unknown. They are not called, they are only occasionally worshipped; their epiphany is dreaded, not reverenced.

The *ibambo* may appear anywhere and at any time and to anybody. But it has no message. It rarely speaks. Its most common effect on human lives is to frighten. It flits; it does not stand or remain in one spot, to speak or to be spoken to. Indistinctly seen, its appearances are reported as occurring mostly in dark places—in shadows, in twilight, and on dark nights. The most common places are lonely paths in the forest by night.

To all intents and purposes these abambo are what superstitious fears in our civilization call "ghosts." The timid dweller in civilization can no more tell us what that ghost is than can the ignorant African. It is as difficult in the one case as in the other to argue against the unreal and unknown. What the frightened eye or ear believes it saw or heard it persists in believing against all proof. Nor will ridicule make the belief less strong. However, the intelligent child in civilization, under the hand of a judicious parent or other friend, and relying on love as an expounder, can be led to understand, by daylight, that the white bark of a tree trunk shimmering in uncertain moonlight, or a white garment flapping in the wind, or a white animal grazing in the meadow, was the ghost whose waving form had scared him the night before. His superstition is not so ingrained by daily exercise but that reason and love can divest him of it. But, to the denizen of Fetich-land, superstition is religion; the night terror which he is sure he saw is too real a thing in his life to be identified, by day time, as only a harmless white barked tree or quartz rock.

3. A third class of spirits is represented by the names *Ombwiri*, *Nkinda*, and *Olaga*. The ombwiri (Mpongwe plural, awiri) is certainly somewhat local, and so far forth might be regarded as the ancient fauns and dryads, with a suggestion of Druidic worship of spirits resident in the dense oak groves and the massive stones of the Druid circle. But the *awiri* are more than dryads. They are not confined to their local rock, tree, bold promontory, or point of land, where they resent trespass by human beings. The traveller must go by silently, or with some cabalistic invocation, with bowed or bared head, and with some offering—anything, even a pebble. On the beach, as I bend to pass beneath an enormous tree fallen across the pathway, I observe the upper side of the log covered with votive offerings—pebbles, shells, leaves, etc.—laid there by travellers as they stooped to pass under. Such votive collections may be seen on many spots along the forest paths, deposited there by the natives as an invocation of a blessing on their journey.

While the ombwiri is indeed feared, it is with a respectful reverence, different from the scare of an ibambo. Ombwiri is something fine and admirable in vision (when seen, which is rare); it is white, like a white person. Souls of distinguished chiefs and other great men turn to Awiri. *Nkinda* are spirits of the common dead. The fear with which the native regards massive rocks and large trees—the ombwiri homes—need not be felt by white people ; white people being themselves considered awiri, their bodies being inhabited by the departed spirits of the negro dead.

4. *Mondi.* There are beings, Myondi (Benga singular, mondi), who are passive agents in causing sickness, or in either aiding or hindering human plans. But they are not always simply passive ; they are often active on their own account, or at their own pleasure, generally to injure. They are invoked at the new moons; and at any other times, particularly in sickness. The native *oganga* decides whether or no they be myondi that are afflicting the patient. This diagnosis being made, and myondi being declared as present in the patient's body, the indication is that they are to be exorcised.

A slight doubt must be admitted in regard to these myondi, whether they do constitute a distinct and separate class, or whether any spirit of any class may not become a mondi. The name in that case would be given them, not as a class but as producers of certain effects, at certain times and under certain circumstances.

5. *Yaka.* There seems to be another class, somewhat like the

ancient lares and penates, belonging to the household, worshipped by a family, and associated with a certain family-fetich called yaka. This form descends by inheritance with the family. In its honour is sacredly kept a bundle of toes, fingers, or other bones, nail clippings, eyes, brains, etc., etc., accumulated from deceased members of successive generations. This is distinctly an ancestral worship.

The worship of ancestors is a marked and distinguishing characteristic of the religious system of Southern Africa. This is something more definite and intelligible than the religious ceremonies performed in connection with the other classes of spirits.—*Wilson.*

What was described by Dr. Wilson as respect for the aged among the tribes of Southern Guinea, forty years ago, is true still, in a large measure even where foreign customs and examples of foreign traders and the practices of foreign Governments have broken down native etiquette and native patriarchal government. Perhaps there is no part of the world where respect and veneration for age are carried to a greater length than among this people. For those who are in office, and who have been successful in trade, or in war, or in any other way have rendered themselves distinguished among their fellow-men, this respect, in some outward forms at least, amounts almost to adoration; and proportionately so when the person has attained to advanced age. All the younger members of society are early trained to show the utmost deference to age. They must never come into the presence of aged persons or pass by their dwellings without taking off their hats and assuming a crouching gait. When seated in their presence it must always be at a "respectful distance"—a distance proportioned to the difference in their ages and position in society. If they come near enough to hand an aged man a lighted pipe or a glass of water, the bearer must always fall upon one knee. Aged persons must always be addressed as "father" (rera, lale, paia) or "mother" (ngwe, ina). Any disrespectful deportment or reproachful language toward such persons is regarded as a misdemeanour of no ordinary aggravation. A youthful person carefully avoids communicating any disagreeable intelligence to such persons, and almost always addresses them in terms of flattery and adulation. And there is nothing which a young person so much deprecates as the curse of an aged person, and especially that of a revered father.

6. Possibly there is a sixth class. There may enter into any animal's body (generally a leopard's) some spirit or, even temporarily, the soul of a living human being. The animal then, guided by

human intelligence and will, exercises its strength for the purposes of the temporary human possessor. Many murders are said to be committed in this way—after the manner of the mythical German *wehr-wolf* or the *loup-garou*.

The powers and functions of the several classes of spirits do not seem to be distinctly defined. Certainly they do not confine themselves either to their recognised locality nor to the usually understood activity pertaining to their class. These powers and functions shade into each other, or may be assumed by members of any class. But (1) it is clearly believed that spirits, even of a given class, differ in power among themselves from the other members of that same class. Some are strong, others are weak. (2) They are limited as to the nature of their powers; not *any* spirit can do *all* things. (3) A spirit's *efficiency* runs only on a certain line or lines. (4) All of them can be influenced and be made subservient to human wishes by a variety of incantations.

1. Functions of the first class, or *Anina*.

While embodied in a human form, they constitute the life-principle that demonstrates itself through the various senses, and that lives after the body is dead, continuing itself in the unseen world, with all the same feelings and actuated by the same passions as when embodied as a human soul.

So few are the special activities by which to distinguish them from other classes of spirits that I might doubt whether they should properly be considered as distinct were it not true that the Anina are all of them *disembodied* spirits; none of them are of other possible origin. As disembodied spirits retaining memory of their former human relationships they have an interest in human affairs, and especially in the affairs of the family of which they were lately members.

2. Functions of the second class, or *Abambo*.

They are one of the two classes of spirits the worship of which forms the most prominent feature in the superstitious practices of the country.

The term *abambo* is in the plural form, and may, therefore, be regarded as forming a class of spirits instead of a single individual. They are the spirits of dead men; but whether they are positively good or positively evil, to be loved or to be hated, or to be courted or avoided, are points which no native of the country can answer satisfactorily. Abambo are the spirits of the ancestors of the people, as distinguished from the spirits of strangers. These are the spirits with which men are possessed, and there is no end to the ceremonies used to deliver them from their power.

3. The functions of the third class, *Awiri.*

These spirits are sometimes spoken of as *Nkinda*, *Olaga* (Mpongwe plural, *Inaga*). They all come from the spirits of the dead. These several names do not indicate a difference as to kind or class of spirit, but a difference in the work or functions they are called upon to exercise. The Inaga are spirits of strangers, and have come from a distance.

The derivation of the word *Ombwiri* is not known. As it is used in the plural as well as in the singular form, it no doubt represents a class or family of spirits. He is regarded as a tutelar or guardian spirit. Almost every man has his own ombwiri, for which he provides a small house near his own. All the harm that he has escaped in this world, and all the good secured, are ascribed to the kindly offices of this guardian spirit. Ombwiri is also regarded as the author of everything in the world which is marvellous or mysterious. Any remarkable feature in the physical aspect of the country, any notable phenomenon in the heavens, or extraordinary events in the affairs of men are ascribed to Ombwiri. His favorite places of abode are the summits of high mountains, deep caverns, large rocks, and the base of very large forest trees. And while the people attach no malignity to his character, they carefully guard against all unnecessary familiarity in their intercourse with him, and never pass a place where he is supposed to dwell except in silence. He is the only one of all the spirits recognized by the people that has no priesthood; his intercourse with men being direct and immediate.

Sick persons, and especially those that are afflicted with nervous disorders, are supposed to be possessed by one or the other of these spirits. If the disease assumes a serious form the patient is taken to a priest or a priestess of one or the other of these spirits. Certain tests are applied, and it is soon ascertained to which class the disease belongs, and the patient is accordingly turned over to the proper priest. The ceremonies in the two cases are not materially different; they are alike, at least, in the employment of an almost endless round of absurd, unmeaning, and disgusting ceremonies which none but a heathenish and ignorant priesthood could invent, and none but a poor, ignorant, and superstitious people could ever tolerate.

In either case a temporary shanty is erected in the middle of the street for the occupancy of the patient, the priest, and such persons as are to take part in the ceremony of exorcism. The time employed in performing the ceremonies is seldom less than ten or fifteen days. During this period dancing, drumming, feasting, and drinking are kept up without intermission day and night, and all at the expense of the nearest relative of the invalid. The patient, if a female, is decked out in the most fantastic costume; her face, bosom, arms, and legs are streaked with red and white chalk, her head adorned with red feathers, and much of the time she prome-

nades the open space in front of the shanty with a sword in her hand, which she brandishes in a very menacing way against the bystanders. At the same time she assumes as much of the maniac in her looks, actions, gestures, and walk as possible. In many cases this is all mere affectation, and no one is deceived by it. But there are other cases where these notions seem involuntary and entirely beyond the control of the person; and when you watch the wild and unnatural stare, the convulsive movements of the limbs and body, the unnatural posture into which the whole frame is occasionally thrown, the gnashing of the teeth, and foaming at the mouth, and supernatural strength that is put forth when any attempt is made at constraint, you are strongly reminded of cases of real possession recorded in the New Testament.

There is no reason to suppose that any real cures are effected by these prolonged ceremonies. In certain nervous affections the excitement is kept up until utter exhaustion takes place; and if the patient is kept quiet afterwards (which is generally the case) she may be restored to better health after a while; and, no matter how long it may be before she recovers from this severe tax upon her nerves, the priest claims the credit of it. In other cases the patient may not have been diseased at all, and, of course, there was nothing to be recovered from.

If it should become a case of undissembled sickness, and the patient become worse by this unnatural treatment, she is removed, and the ceremonies are suspended, and it is concluded that it was not a real possession, but something else. The priests have certain tests by which it is known when the patient is healed, and the whole transaction is wound up when the fees are paid. In all cases of this kind it is impossible to say whether the devil has really been cast out or merely a better understanding arrived at between him and the person he has been tormenting. The individual is required to build a little house or temple for the spirit near his own, to take occasional offerings to him, and pay all due respect to his character, or to be subject to renewed assaults at any time. Certain restrictions are imposed upon the person who has recovered from these satanic influences. He must refrain from certain kinds of food, avoid certain places of common resort, and perform certain duties; and, for the neglect of any of these, is sure to be severely scourged by a return of his malady. Like the Jews, in speaking of the actions of these demoniacs, they are said to be done by the spirit, and not by the person who is possessed. If the person performs any unnatural or revolting act—as the biting off of the head

of a live chicken and sucking its blood—it is said that the spirit, not the man, has done it.

But the views of the great mass of the people on these subjects are exceedingly vague and indefinite. They attend these ceremonies on account of the parade and excitement that usually accompany them, but they have no knowledge of their origin, their true nature, or of their results. Many submit to the ceremonies because they are persuaded to do so by their friends, and, no doubt, in many cases in the hope of being freed from some troublesome malady. But as to the meaning of the ceremonies themselves, or the real influence which they exert upon their bodily diseases, they probably have many doubts, and when called upon to give explanation of the process which they have passed through, they show that they have none but the most confused ideas.

4. The functions of the fourth class, *Myondi.*

These are much the same as those of the third class, except that in power they seem to be more independent than other spirits. They are active, self-willed, and generally malignant causers of disease, and they are worshipped almost always only in a deprecatory way. They often take violent possession of human bodies; and for their expulsion it is that Inaga, Nkinda, and Awiri are invoked.

5. Functions of the spirit of the family-fetish, *Eyaka* (Benga plural, Byaka). The respect for parents and other aged persons already referred to in this chapter,

by a very natural operation of the mind, is turned into idolatrous regard for them when dead. It is not supposed that they are divested of their power and influence by death; but, on the contrary, they are raised to a higher and more powerful sphere of influence, and hence the natural disposition of the living, and especially those related to them in any way in this world, to look to them and call upon them for aid in all the emergencies and trials of life. It is no uncommon thing to see large groups of men and women, in times of peril or distress, assembled along the brow of some commanding eminence, or along the skirts of some dense forest, calling in the most piteous and touching tones upon the spirits of their ancestors.

Images are used in the worship of ancestors, but they are seldom exposed to public view. They are kept in some secret corner, and the man who has them in charge especially if they are intended to represent a father or predecessor in office, takes food and drink to them, and a very small portion of almost everything that is gained in trade.

But a yet more prominent feature of this ancestral worship is to be found in the preservation and adoration of the bones of the dead, which may be fairly regarded as a species of relic worship. The skulls of distinguished persons are preserved with the utmost care, but always kept out of sight. I have known the head of a distinguished man to be dissevered from the body when it was but partially decomposed,

and suspended so as to drip upon a mass of chalk provided for the purpose. The brain is supposed to be the seat of wisdom, and the chalk absorbs this by being placed under the head during the process of decomposition. By applying this to the foreheads of the living, it is supposed they will imbibe the wisdom of the person whose brain has dripped upon the chalk.

In some cases all the bones of a beloved father or mother, having been dried, are kept in a wooden chest, for which a small house is provided, where the son or daughter goes statedly to hold communication with their spirits. They do not pretend to have any audible responses from them, but it is a relief to their minds in their more serious moods to go and pour out all the sorrows of their heart in the ear of a revered parent.

This belief, however much of superstition it involves, exerts a very powerful influence upon the social character of the people. It establishes a bond of affection between the parent and child much stronger than could be expected among a people wholly given up to heathenism. It teaches the child to look up to the parent not only as its earthly protector, but as a friend in the spirit land. It strengthens the bonds of filial affection, and keeps up a lively impression of a future state of being. The living prize the aid of the dead, and it is not uncommon to send messages to them by some one who is on the point of dying; and so greatly is this aid prized by the living, that I have known an aged mother to avoid the presence of her sons, lest she should by some secret means be dispatched prematurely to the spirit world, for the double purpose of easing them of the burden of taking care of her and securing for themselves more effective aid than she could render them in this world.

All their dreams are construed into visits from the spirits of their deceased friends. The cautions, hints and warnings which come to them through this source are received with the most serious and deferential attention, and are always acted upon in their waking hours. The habit of relating their dreams, which is universal, greatly promotes the habit of dreaming itself, and hence their sleeping hours are characterized by almost as much intercourse with the dead as their waking hours are with the living. This is, no doubt, one of the reasons of their excessive superstitiousness. Their imaginations become so lively that they can scarcely distinguish between their dreams and their waking thoughts, between the real and the ideal, and they consequently utter falsehood without intending, and profess to see things which never existed.—See DR. WILSON, *Western Africa.*

All that is quoted above from Dr. Wilson is still true among tribes not touched by civilization. What he relates of the love of children for parents and the desire to communicate with their departed spirits is particularly true of the children of men and women who have held honourable position in the community while they were living. And it is also all consistent with what I have described of the fear with which the dead are regarded and the dread lest they should revenge some injury done them in life. The common people and those who had neglected their friends in any way would be the ones who would dread this. The better classes, especially of the superior tribes, would be the ones to hold their dead in affectionate remembrance.

I have met with instances of the preservation of a parent's

brains for fetich purposes, as mentioned above by Dr. Wilson. As honoured guest I have been given the best room in which to sleep overnight. On a flat stone, in a corner of the room, was a pile of greyish substance; it was chalk mixed with the decomposed brain matter that had dripped on it from the skull that formerly had been suspended above it. I then remembered how, on visiting chiefs in their villages, they frequently were not in the public reception room on my arrival; but I was kept awaiting them. They had been apprized of the white man's approach, had retired to their bedrooms, and when they reappeared it was with their foreheads and sometimes with other parts of their bodies marked with that greyish mixture. The object was that they be given wisdom and success in any question of diplomacy or in a favour they might be asking of the white man.

6. Functions of what is possibly a sixth class.

This belief in demoniacal possession of a lower animal must not be confounded with the equally-believed transmigration of souls. It is widespread over at least a third of the African continent. In Mashonaland

they believe that at times both living and dead persons can change themselves into animals, either to execute some vengeance or to procure something they wish for; thus a man will change himself into a hyena or a lion to steal a sheep and make a good meal off it; into a serpent to avenge himself on some enemy. At other times, if they see a serpent it is one of the Matotela tribe or slave tribe, which has thus transformed himself to take some vengeance on the Barotse (*Dècle*).

CULEBRA ISLAND.

BY

A. C. HAESELBARTH.

Culebra Island is a part of Porto Rico, and was ceded with Vieques by the Treaty of Paris. It is 53 miles from San Juan, 17 miles from St. Thomas, and 19 miles from Vieques. Its exact situation is between latitudes 18° 15′ and 18° 23′ north and longitudes 65° 10′ and 65° 25′ west. It is a bunch of picturesque hills, ranging in height from 150 to 650 feet. The island proper is approximately 7 miles long and 3 miles wide. Northeast island, 1 mile long, is 2½ miles from the mainland, and Culebrita, of the same size, is 3¼ miles from the mainland, and bears, on a bluff 300 feet high, a lighthouse in which is a fixed white light that can be seen 21 miles at sea.

Culebra proper has numerous harbours, of which the best are Target Bay, Great Harbour, and Mosquito Bay on the south side; Swell Bay, Surf Bay, and Flamingo Bay on the north side, and Mangrove Harbour at the east end. The village of Culebra and the marine camp are at the head of Great Harbour, which is practically landlocked. On the highest hill of the island, at an elevation of 650 feet, is the Government signal station, from which the approach of a large vessel or fleet from any direction can be seen thirty miles out at sea. A telephone line connects this station and the marine camp. Thus far no attempt has been made to fortify the island beyond mounting a 5-inch gun in a commanding position and three smaller guns at the marine camp. The island, however, could quickly be made a formidable spot, being a natural fortification.

Great Harbour, which the Government is said to favour as a naval station in preference to San Juan harbour, Porto Rico, was so named by the British, but has long been called Ensenada Honda by the Spanish and Porto Rican mariners, who have taken refuge in the same many times. It is protected from the winds and defended on all sides. Its waters are as tranquil as those of a lake, and the largest fleet in the world can find accommodation therein, in view of the depth and the fact that its bottom is free from all obstructions. A small canal could be cut through the little neck of land in the Playa Sardinas so as to establish an outlet for the waters of

the harbour. This bay, so favoured by nature, can be considered the finest harbour in the Antilles, and the one that has suffered the least from the havoc of cyclones.

One and a half miles to the southwest of Culebra lies the isle of Luis Peña or Southwest Island, which is about a mile long, and is in a complete state of abandonment. This isle and the Punta del Soldado form the harbour that has been used from time immemorial by the warships that visit the island for exercises, on account of the fact that it is well defended and has two beautiful shores, suitable for effective landings.

On the north coast there is no port except the small open bay called Flamencos or Flamingo, which can be entered at a great risk by small boats only.

The camp at Culebra, called Camp Roosevelt, is on a bluff near the village, and is cooled by an ever-present breeze. Fresh water is supplied from a big water barge in the bay, potable water being extremely scarce in the island. There are no rivers, but in the rainy season a stream is formed in a ravine running from the centre of the island to the east of the village and emptying into Great Harbour.

It is a lack of water that is likely to prove the most serious drawback to the future development of Culebra. The water is mostly brackish. Copious wells have been dug in several places. The waters of these wells are given to cattle and are used for domestic purposes ; there are, however, four or five of them whose waters are drunk by the colonists. In the town there are two public cisterns of regular size. One of these was built in 1889, during the Spanish administration, with Government funds and with the aid of the colonists ; the other one was built after the occupation of the island by the Americans with moneys collected for the relief of the victims of the cyclone of "San Ciriaco" (Aug. 8th, 1899), and donated by the Board of Charities to the inhabitants of Culebra. There are also some private cisterns in the town and in the country, in which rain water is collected.

There is a hamlet to which, when founded, was given the name of San Ildefonso ; there are several streets in this hamlet, which has sixty-two houses of fair construction, and in the four wards, viz.: Pueblo, San Isidro, Fraile, and Playa Sardinas, there are about eighty-five houses, twenty of which are fairly good, while most of the others are mere huts ; the total number of inhabitants is 704.

The products of the island are maize, beans, and other grains,

plantains, bananas of various kinds, sweet potatoes and other tubers, and fruits, such as cocoanuts, mangoes, etc. There are good farms fit for cattle-raising ; and the raising of domestic fowls is very easy. Several experiments have been made in sugar-cane-raising, and the results have been very good. Quite a little tobacco is raised on the island, and this is manufactured into chewing tobacco on account of its juiciness. Cotton, also, is produced, and yields abundant crops of a very superior quality of fibre. This plant grows in a semi-wild state, and the care of it costs very little.

The island suffers greatly from drought on account of its small size, and because the strong winds keep the rains from falling five or six months in the year. When the products of the island had a market in St. Thomas, agriculture flourished; but since 1898, when the island lost the privilege of taking its products to the Danish West Indies, its only market, agriculture was abandoned, and to-day yields but very little.

The commerce of the island is in the hands of five merchants, who do business on a small scale, and who import the goods they handle from San Juan, Fajardo, and Vieques. There are no industries, and the exports of the island consist of the minor produce, shipped to Vieques, Fajardo, and even to San Juan ; cattle, shipped to Vieques, Fajardo, and San Juan, and in some years to St. Thomas ; tortoise shells, which abound on the island, and are shipped to the same markets as the cattle.

The cattle are as fine as any in the world; and I venture the opinion that cattle-raising in Culebra will yet yield big profits to men who engage in it. There are now on the island 2,215 head of cattle, divided as follows : Horses, 201 ; asses, 4 ; bovine cattle, 1,355 ; sheep, 150 ; goats, 325 ; swine, 180. These are valued at $27,911.

There are sixty-six country properties, with about 4,000 "cultivated" acres, of which 2,639 acres are simply cleared lands devoted to pasture. Tobacco, bananas, and minor products use about 300 acres, and there are 900 acres of wood and brush land. By President Roosevelt's order of December 18, 1901, all the public lands were put under the control of the Navy Department, excepting some in the interior of the island. The use of plots a little more than sixty acres each can be obtained in return for labour for the Government, but the holders are liable to eviction on brief notice.

The public buildings on the island are few. There are two schoolhouses, built with insular funds in 1892 ; a tiny Catholic

church, built in 1890 by the Catholics of Porto Rico; a police station, now used as a residence of school teachers; and the public cistern. There is a tiny wharf, at very deep water, where, if a naval station is established, the coal piles will be located. The Governor lives in the Casa Blanca, a two-story unpainted frame building near the wharf. There is a cemetery, to which an average of but four bodies a year are added, and on the wall of which rests the public coffin, in which all corpses are carried to the burying-ground.

Up to the beginning of the last century this island was the lurking-place of pirates, whence a little key in this splendid bay derives its name. This bay was called Great Harbour by the English, who drew the first plan or map of the island, sometime about 1838.

The first name of the island was Isla del Pasage, which seemed to indicate that it was the proper place to stop at in long inter-oceanic navigations; but later on Porto Rican mariners and fishermen changed this name to Culebra, which means *snake*, on account of the peculiar shape of the island.

Up to 1880 the island was visited by none but small craft conveying persons engaged in fishing, charcoal-burning, and wood-chopping; the best timber, such as the Guayaco (*Guaiacum officinale*), being felled and taken to St. Thomas, St. Croix, or other islands, without any permission; and it is to be supposed that this was what led the Government of Spain to look upon colonizing the island as a necessity.

Between 1870 and 1876 there lived on the island, at the place called "Tamarindo," one Stiven, a negro from Tortola (British colony), who called himself the Governor of the island, and commanded the respect of even the Porto Rican fishermen. Stiven was found murdered one day, and when the news of this assassination reached the Spanish authorities in Vieques they sent troops to Culebra; twelve small foreign boats were seized, and about forty men engaged in fishing, charcoal-burning, and wood-chopping without permission from the representatives of the Spanish Crown were arrested. Much attention was drawn towards the colonization of the island by this event; and had it not taken place it is nearly certain that the "Tortoleños," or inhabitants of Tortola, who are British subjects, would have taken possession of the island. It also happened that foreign men-of-war, especially German, used the water and shores of the island for naval exercises, and evidences of this are still found in many parts of the southern coast and in the most accessible parts of the island, where projectiles

have been found which, on account of their shape, etc., are calculated to be at least fifty years old. In 1887 three German men-of-war visited the island with the object of making naval exercises, and a force of the Guardia Civil was sent to the island to afford protection to the delegate, whose presence in Culebra, with many colonists, proved that Spain had occupied the island.

A circular issued by the General Government of Porto Rico on May 13th, 1879, opened the road to colonization of Culebra, and a Royal Order of March 15th, 1881, granted, among other concessions, that of freedom of the ports of the island.

It was not until 1884–1885 that the amounts necessary to defray the expenses of the colonization of the island of Culebra were included in the budget of Porto Rico.

In 1886 trafficking between St. Thomas and Porto Rico, conducted in sailing craft, assumed such importance that it attracted the attention of the Spanish Consul at St. Thomas, who communicated with the General Government of Porto Rico on the matter. It happened that the port of the island of Culebra was used as a roadstead by the smugglers, who, evading the vigilance of the revenue officials, introduced into Porto Rico from St. Thomas goods subject to the payment of import duties. One of the principal articles smuggled was Kentucky and Virginia leaf tobacco. The result was that the traffic in vessels plying between St. Thomas and Culebra was declared illegal, except when the vessels had secured a written permit from the Consul of Spain at St. Thomas.

Official statistics show that in 1894 goods valued at $6,630.49 were imported into Culebra, and products of this island, valued at $7,184.20, were exported.

The most important articles were : cattle, sweet potatoes, plantains, chewing tobacco, pumpkins, beans, domestic fowls, tortoise shell, charcoal, Indian corn, and mangle bark.

Delegate Delgado says that great damage has been done to the interests of the island by annexing it to Vieques, in view of the distance that separates the two islands. He thinks that Culebra should continue as heretofore—never as a dependency of any other municipality of Porto Rico. He says it is necessary, in view of the exceptional condition of its coasts and ports, that the Governor of Porto Rico have a special representative in the island, since it is periodically visited by war vessels, and is called to be a stronghold, naval station, coaling station, or a penitentiary.

It may be said that there are no roads in Culebra, travelling being entirely over narrow trails, on sure-footed horses. These

horses are worth from $30.00 to $50.00 there. The natives ride, as they do elsewhere in the West Indies, with huge wicker baskets on either side of the little beasts, which patiently carry heavy loads. Everywhere the undisturbed charm of the tropics remains. The views are magnificent from the hills, and the gallops along the stretches of beach by a rolling surf are never to be forgotten.

THE ECONOMIC GEOGRAPHY OF THE ARGENTINE REPUBLIC.

BY

J. RUSSELL SMITH.

General Description.—The Argentine Republic is, in a general way, the southern counterpart for the region lying between the Missouri-Mississippi River and the watershed of the Rocky Mountains. Each of these sections begins near the tropics, with a region of heavy rainfall and forests. From these centres of humidity the rainfall decreases toward the interior, and is accompanied by corresponding changes in the vegetation. In the United States the low-lying eastern part of the western half of the Mississippi Valley is forest-covered; then to the westward are the open plains, where corn and wheat are grown, the wheat going the farther westward, and finally giving way in the region of increasing aridity, where only pastoral industries can survive without irrigation. The supply of water for this purpose is mainly derived from the mountain streams at the western edge of the Great Plains, where thriving agricultural settlements are growing up in New Mexico, Colorado, and Montana. The Argentine Republic duplicates these zones. She has in the northeast a rainy forest belt, a corn belt, a wheat belt, then a wide stretch of semi-arid and arid plain, and finally at the foot of the Andes a succession of agricultural settlements, depending upon the water supply from the Andean snowfields. Both of the regions under consideration are extended and usually level plains that have been in great part deposited by erosion from the continental axis to the westward; but the comparison must not be carried too far, for there are minor differences that make Argentina the least valuable of the two areas. The forested region is smaller, and the wood less valuable; the grain-growing belt is nar-

rower, the arid belt is more arid, and the greater length from north to south gives the Argentina a tropic section in the latitude corresponding to Yucatan, and a cold temperate section reaching a higher latitude than the Saskatchewan River in Assiniboia. Despite these drawbacks, the Argentine Republic has large production and larger possibilities in both pasturage and agriculture, and considerable promise in her forests and minerals.

Mineral Resources.—The present mineral production of Argentina is slight. Lignite is found in several provinces, but it has not been successfully utilized, and, owing to the lack of coal, there is no iron manufacture. A small amount of petroleum is produced in Mendoza. In the extreme northwest, in the high and desert plateaux of the Andes, are extensive deposits of borates, which have recently been worked in a small way, but there is as yet no adequate outlet by which the product can reach the sea coast. Gold is found in the Andes, but the operations have been insignificant, and chiefly in the far south, where placer mines have been exploited in the Island of Tierra del Fuego. In 1900, 212 ounces of gold were produced.

Despite the meagre output of minerals, there is good geological reason for the belief that there is considerable mineral wealth. Western Argentina comprises the eastern slope of the Andean mountain system. The western side of this range in Chile is rich in deposits that are probably duplicated in some places on the other side of the range. Ore finds are constantly being reported in Argentina, but the great distance from a base of operations upon the sea coast and the lack of transport facilities have thus far prevented their development. The great agricultural and pastoral resources of the country have provided employment for the scanty supplies of labour and capital.

Forest Resources.—The forest resources of the Argentine Republic lie at the extremes of the country—the tropic and sub-tropic forests of the north and the evergreen forests of the south. Both are so far away from the centres of population and industry, and in locations so difficult of access, that the greater part of the lumber supply has been imported. The southern forests of Araucanian pine occupy considerable areas along the Andes in lower Patagonia and in Tierra del Fuego. Some lumbering has been done in places easily accessible from the sea, but this region is a remote and, until recently, unsettled frontier, as far from Buenos Aires as the coast of southern Labrador is from Boston.

The northern forests are made to contribute more to the economic life of the Republic, yet the larger part of this section is as little known as interior Patagonia. It is known as "El Gran Chaco" (the Great Hunting Ground), and is held by a few wandering tribes of hostile Indians, who have thus far resisted all efforts to explore the interior. The tree growth begins with thorn thickets as far south as the Rio Colorado, in about latitude 41°. These thickets are replaced northward by groves of small trees suitable for fuel and posts, and giving a park landscape to the eastern part of Pampa Territory and much of Cordoba. This growth does not go eastward into the Province of Buenos Aires nor into Santa Fé until latitude 31° is reached. Here the increasing rainfall raises the tree growth into a forest that extends northward into Bolivia, and often presents impassable jungle. The most valuable product of this zone is the wood of the red quebracho tree, commonly called quebracho colorado (*Quebrachia Lorentzii* or *Loxopterigium Lorentzii*). It has great hardness, weight, and durability, and produces a valuable extract containing tannin. The wood lasts well in air, water, or earth, and has been widely used in the construction of Argentine railroads, serving as ties, bridge timbers, and telegraph poles. The tannin content is usually from 10–20%, but the finest grade of quebracho growing in a strip from fifteen to twenty miles wide along the west bank of the Parana is said to yield from 22 to 28%.* The high quality of leather produced by this extract has led to the exportation of the wood to Europe. The shipments † were 29,700 tons in 1892, 155,000 tons in 1895, 225,000 tons in 1900. It was all used for tanning purposes, and successful experiments at extracting the tannin near the scene of production have caused a large increase in the business, which has attracted German, British, French, and American capital.

The quebracho tree is from 35 to 45 feet in height, from 12 to 40 inches in diameter (rarely above 20), and is found‡ in abundance in the region bounded by 30° and 22° south and 58° and 65° west longitude. This area of 125,000 square miles is larger than Georgia and Florida combined, and, according to the estimate of a recent German writer,§ contains reserves of quebracho wood to the extent

* Bulletin of Bureau of American Republics. Vol. XI, p. 881.

† Bulletin of Bureau of American Republics, Vol. XI, p. 881.

‡ K. Kaerger Landwirtschaft & Kolonisation im Spanischen Amerika. 1 Band. Die La Plata-Staaten. Duncker & Humblot, Leipzig, 1902, p. 816.

§ Quoted in Annales de Géographie, No. 57, p. 258.

of 168,750,000 tons—enough to give secure basis for a large development of the lumber and tannin industries.*

The Pastoral Industries.—The pastoral industries furnish the most important element in the wealth of the Argentine Republic. This country, like the western part of the Mississippi Valley, began its industrial history as a cattle range. This was the leading industry and the sole basis of the export trade from the founding of the colony late in the 16th century until 1848, when regular exports of wool began and increased with great rapidity.

About the middle of the 19th century efforts to introduce agriculture resulted in the successful growing of grain. The supply was inadequate for the home market, and regular importations were made from southern Brazil, Chile, and other countries till, in 1873, a surplus of wheat was placed upon the world's market. Since that date the advance has been rapid, and Argentina is now an important exporter of grain. The development of agriculture has not, however, caught up with the pastoral industries, which still furnish over half of the total exports of the country.

The cattle and sheep reported by the census of 1895 were respectively 21,702,000 and 74,380,000. In 1900 the cattle were estimated at 28,000,000, giving Argentina the third rank—United States having 44 million and Russia 30 † million. In 1901 the estimated number of sheep was 120‡ million, giving Argentina the first rank, as Australia had 70 million in 1900 and the United States 42 million. The wool clip was 250,000 tons in 1901.

The exports of animal products were valued at 115½ million dollars in 1899, and 71¼ millions in 1900. Wool is the most important item, but improvements in transportation are making meat and live animals of increasing importance. Both are now regularly shipped to Europe, more than 100,000 live animals having been sent in a single year. In 1900 (the latest statistics available) the shipments of frozen meat amounted to 261,000 quarters of beef and 2¼ million sheep. Other important articles are hides, sheep skins, tallow, and jerked beef for consumption in tropical countries.

The uneven distribution of the flocks and herds throughout the country is, like the agriculture, dependent upon varying climatic

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* The merchantable quebracho is all found north of a line running from the Parana at 31 S. to El Recreo 65 W. 29⅓ S., thence along the slopes of the Andes.

† Annales de Géographie, p. 252.

‡ Bulletin of Bureau of American Republics, July, 1901, p. 48.

conditions. As barns for stabling or shelter for live stock are practically unknown in Argentina, the questions of moisture and temperature are doubly important, affecting as they do every condition, both of food supply and physical survival. Cattle are not well protected by nature against cold, and the herds do not thrive south of the Province of Buenos Aires.* The winter temperature is sometimes extreme, and the "pampero" or southwest windstorms blow from the Patagonian highlands with great severity. The extremes of moisture and heat, however, are borne by cattle better than by any of the other domestic animals of the temperate zone. They can survive an annual rainfall of 80 inches, and the cattle industry extends northward into Salta and Jujuy, the subtropical provinces of the northwest, and, in a small way, even in the rainy northeastern territories of Formosa and Misiones. The horse is somewhat like the ox in his climatic requirements, but does not thrive in a rainfall of more than 55 inches in the Argentine, and therefore his northern limit is more restricted than that of the ox. Moisture is even more disadvantageous to sheep, and they do not thrive north of the line of annual precipitation of 40 inches. The strong points of the sheep are resistance to cold and hunger. The fleece enables them to endure the storms of Patagonia, and they can fast for considerable periods when necessary, and they will also paw through a foot of snow to obtain food. As a result of this hardihood, the shores of Patagonia and even of Tierra del Fuego are rapidly being taken up as sheep ranges. Many of the settlers are British subjects coming across from the Falkland Islands, where for a century they have carried on sheep-raising under somewhat similar climatic conditions, and developed a hardy breed of Falkland sheep. The flocks of Patagonia increased from 30,800 in 1881 to two million in 1895, and have had large increase since that date. Parts of interior Patagonia are high, arid, and rocky, but recent explorations have shown that, toward the foot of the Andes and south of 40° latitude, there is a promising country of lakes, forests, pastures, and fair rainfall. The climate here is said to resemble that of Scotland, which is also pre-eminently a sheep country. It is a curious fact that nearly all of the sheep of Argentina are owned or controlled by Englishmen or Scotchmen, who have brought hither their breeds of sheep and their knowledge of caring for them. The cattle industry remains in the hands of the more military Spanish and half-breed races.

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* Annales de Géographie, p. 253.

The pastoral industry is scattered over a wide area, yet the greater part of it is concentrated near the lower course of the Parana River.* The alluvial pastures of southern Entre Rios and northern and northeastern Buenos Aires are the *pasto tierno* (soft annual grasses), and especially famed for producing the finest fat cattle, sheep, and wool. This district has all the advantages of fertile soil, good climate, satisfactory rainfall, and nearness to the markets. Going inland in any direction is a rapid decrease in the number of animals that can be supported per unit of area, because the pasture is harsh perennial bush grass (*pasto fuerte*, "pampas grass"), beginning at the edge of the 40-mile alluvial strip along the river. The value of this pasture has been greatly increased by the planting of alfalfa in places as far west as Victoria, in eastern Pampa. Beyond the alfalfa limit the land supports less than one sheep per acre.†

Agriculture.—The real beginnings of Argentine agriculture were in the decade 1870–80. Following the almost contemporaneous example of Kansas and Nebraska, railroads were built out into the cattle and sheep ranges, the improved reaping machinery was introduced, and agriculture on a large scale was begun. In 1883 the railroad from Buenos Aires to Mendoza was completed and a market opened for this district, which had been settled from the Pacific coast, and which had had an economic existence much like that of the Mormon settlements on Salt Lake before the opening of the Union Pacific Railway in 1869. The new outlet gave an impetus to a fruit and wine industry that now goes far to supply the wants of the country. The opening of a railway to Tucuman has produced a similar development of the sugar industry in that province. The agriculture of the western districts has been in the main only an attempt to supply food products to the home market. The agricultural exports—wheat, Indian corn, and flaxseed—are all produced in the eastern district. The census of 1895 showed that, in

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* Punta Arenas, in Chilean territory on the Straits of Magellan, has already become the centre of a large meat industry, and is a regular port of call for European steamers. Even the Island of Cape Horn has been found to have water supply and pasture, and an expedition has been dispatched to establish a lighthouse there.

The Census of 1895 returns 17,614,000 cattle, 68,444,000 sheep, and 3,422,000 horses in the five eastern provinces of Buenos Aires, Entre Rios, Cordoba, Santa Fé and Corrientes. The same census gave the total figures for the entire country as follows: Cattle, 21,690,000; sheep, 74,380,000; horses, 4,447.000. The area marked upon the accompanying map as the possible wheat area, along with a narrow strip to the north of it, contains 80 per cent. of the cattle and 95 per cent. of the sheep.

† Kaerger, p. 232.

a total wheat acreage of 5,061,000 acres, 4,915,000 acres were in the provinces of Buenos Aires, Cordoba, Entre Rios, and Santa Fé. In 1901* the same States had 4/5 of the wheat acreage and a larger share of the flax and corn.

As in the new grain-growing sections of the United States, the Argentine farming operations began on a large scale, and with no regard to methodical agriculture. The breaking up of the large estates into farms has not followed, as in this country. The Argentine agriculture is still in the plantation stage.† The farmer is the European peasant, usually Italian, who rents land as best he can, frequently on short terms, from the representatives of absentee landholders. His house is a temporary structure; he piles his grain upon the ground; he often wanders from place to place; and the methods of culture are crude and primitive. The wheat and corn acreage fluctuate from year to year, according to the crop conditions and price prospects. If wheat has done poorly and corn prices are high, corn is planted, and the reverse conditions are true. The uncertainty of Argentine grain-growing is indicated by the irregularity in acreage, product and exportation.

The irregular rainfall produces droughts and floods, and the plague of locusts has many times worked great destruction to crops, at times even threatening to annihilate agriculture in provinces north of Buenos Aires Province. Persistent effort has reduced the loss from this source.

GRAIN PRODUCTION. (From Statesman's Year Book.)

	WHEAT.		MAIZE.		FLAX.	
	ACRES.	TONS.§	ACRES.	TONS.	ACRES.	TONS.
1895–6.‡	5,500,000	1,400,000	......	......	......	......
1896–7..	5,500,000	1,500,000	......	......	......	......
1897–8..	......	......	......	......	......	......
1898–9..	7,904,000	2,500,000	......	......	......	......
1899–00.	5,476,000	1,850,000	......	1,000,000	646,000	170,000
1900–01.	8,449,372	2,871,440	......	2,000,000	1,518,000	390,000

* Bulletin of Bureau of American Republics, October, 1901, p. 674, and Statesman's Year Book.

† Bulletin of Bureau of American Republics, August, 1901, p. 216.

‡ Two years must be given because the southern summer, the growing season, is from November to April.

§ Metric ton, 2,204 lbs., or 36.73 bushels of wheat.

GRAIN EXPORT.* (Tons.)

	WHEAT.	MAIZE.	FLAX.
1895..........	1,010,269	772,318	......
1896..........	532,001	1,570,517	......
1897..........	101,845	347,942	162,477
1898..........	645,161	717,105	158,954
1899..........	1,713,424	1,116,276	217,713
1900..........	1,929,676†	713,248	223,257
1901..........	904,289	1,112,290	338,828
1902..........	Est. 700,000	......	......

The wheat area of the Argentine is limited by the conditions of rainfall and water supply. With the exception of southern Patagonia and certain parts of the Andes, the soil and temperature are suitable for wheat, but the rainfall is inadequate, or at the wrong season, over the greater part of this area. From 39° S. to the Bolivian boundary there is a zone near the Andes where the average annual rainfall is less than eight inches. Successful wheat-growing requires this much as a minimum, and it must fall during the growing season of winter and spring. Wheat can only grow here with irrigation.

In the north of Argentina there are districts (as in the Province of Santiago del Estero) having 28 to 32 inches of rain per year; but irrigation is necessary here also, because the heaviest rainfall is in summer, when it is unavailable for wheat. In going northward from the latitude of Buenos Aires and westward from the Parana, the rains of summer tend more and more to predominate over the winter rains. With this distribution, wheat requires in the warmer districts a minimum of at least 40 inches per year. In the south, where the winter rains predominate and the loss from evaporation is less, 16 inches per annum will suffice for wheat. This condi-

* Figures from Statesman's Year Book, excepting those for 1901, 1902, and those or flax, which came from Bulletin of Bureau of American Republics.

† Amounting to more than 70 million bushels. Exports of wheat from the United States were as follows in million bushels:

1897..	79
1898..	145
1899..	139
1900..	102
1901..	132

tion does not prevail south of a N.W.-S.E. line connecting Villa Mercedes and Bahia Blanca; and from Bahia Blanca southward irrigation is necessary in the seashore region also. The north, west, and south are thus debarred from wheat culture. The north-east, with rainfall of 40–75 inches, is also debarred, because the heat, combined with excess of moisture, renders the wheat liable to disease, makes the grain of bad quality, and is liable to spoil it in the harvest. The wheat district is, therefore, confined to a rough parallelogram in the eastern central part of the country, comprising all of the Province of Entre Rios, nearly all of Buenos Aires, more than half of Santa Fé and Cordoba, and a corner of the Territory of Pampa.*

This is a splendid territory. It is nearly all level plain and unencumbered with forest, except for 60 miles in the north and some bush lands in the west. Much of it is alluvial soil, and the rest is of exceptional fertility in potash and phosphoric acid.† The area is as large as that part of Missouri beyond the Missouri River, all of Arkansas and Indian Territory, and the arable parts of Oklahoma, Kansas, and Nebraska,‡ 247,000 square miles, or 158,000,000 acres. Owing to the exceptional smoothness of the land, it is probable that 14,000,000 acres will cover the inarable part, leaving 144,000,000 acres for the plough. Assuming a three-year rotation, such as is successfully practised in the best farming districts of the United States, there will be 48,000,000 acres per year for wheat—eight times the present acreage. §

Such a system would preserve or increase the fertility of the soil, enable production to continue indefinitely, and, with the two intervening crops, probably support as many cattle and sheep as it does at present. Such methodical agriculture is as yet remote, but the extension on new lands of the present extensive system

* These boundaries (from Kaerger, p. 408–15 and 873–6) are approximate only, especially on the west. Some writers claim a larger territory in that direction, and there seems to be a tendency for rainfall to increase with cultivation.

† See analyses in Kaerger, p. 9. At the Colony of Esperanza, near Santa Fé, the same land has produced an undiminished yield of wheat for 40 years.

‡ The limit of successful agriculture in these States nearly coincides with the 100th meridian west of Greenwich.

§ It would be possible between the longitude of Buenos Ayres and San Luis and the 33rd and 37th parallels to have a wheat-field with the furrows 300 miles long and the headlands 200 miles wide, with no further incident to break its monotony than an occasional narrow streamlet and here and there the cluster of one-storied houses forming the local townships.—[From a letter from *Herbert Gibson, Esq.*, an English writer owning extensive sheep ranches in the Argentine.]

of grain-growing could produce a much greater yield for a limited period. The best of agricultural systems will not prevent the serious fluctuations resulting from the irregularities of rainfall, which occasionally flood or parch the crops, and the present stationary wheat average is not indicative of an agricultural revolution.

Maize, or Indian corn, requires for successful growth summer rains and a higher annual average than will suffice for wheat. It also survives, uninjured, the humidity that is fatal to wheat, and a hot summer is favourable to its perfection. The Argentine possesses a corn belt of large but uncertain area in the eastern part of the wheat region, and in the more humid northeast. The production is not so important or so promising as the wheat crop. The greater part of the possible corn land is covered with forest, which can only be cleared at considerable expense, and the sub-tropic and tropic climate is uninviting to settlers. The market conditions have not been satisfactory. The pork industry furnishes the most natural home market for corn, and thus far the raising of swine has made small progress.

Flax cultivation is at present rapidly on the increase. It is grown for the seed only, the yield being about the same as that of wheat, and sometimes greater. The area of cultivation is limited almost entirely to the alluvial valley of the Parana, north of Buenos Aires.*

The agriculture of western Argentina is of an entirely different character from that of the east. Instead of herdsmen and the roving laborers of one-crop grain farming, the Andean valleys are populous with tillers of the soil who follow the more intensive methods of irrigation farming. The area that can be supplied with water is comparatively small, but is as yet far from being fully developed. The dependence upon high mountains for the water supply limits the irrigation belt to the neighbourhood of the Andes and the Mountains of Cordoba, where a second irrigation community has grown up on the east side of the north and south Sierra de Cordoba.

The building of two railroads across the Great Plains to the foot of the Andes has caused the development of two western provinces, and has given the people of Argentina a domestic supply of three commodities which had before been imported—wine, fruits, and sugar.

The planting of cane and the manufacture of sugar are confined

* Kaerger, 455.

almost exclusively to the small province of Tucuman. There are at the same time other districts with climatic conditions as well or better suited to the growth of cane. The northeastern part of the country—the territories of Formosa, Chaco, Misiones, and northern Corrientes—have a warmer summer, a suitable rainfall, and less danger of winter frost; but Tucuman has the security of irrigation, and the more wholesome climate made it one of the early districts settled, while the northeast remains almost a wilderness, with very small increase in population. In 1830 the culture of cane was begun in Tucuman; the industry has remained there, and in spite of the low percentage of sugar and the poor yield per acre,* it has increased since the opening of the railroad, and now supplies the entire country with a surplus for export. The industry would probably decline but for the protection of a favorable tariff, which the country appears willing to continue. In 1895 the acreage was 82,000; and in 1899, 120,000, with 103,000 tons of sugar. According to a calculation made in 1894, the industry employed 60,000 laborers, who had come from provinces adjacent to Tucuman, 6,000 wagons and carts, and 60,000 work animals; 500,000 tons of wood were brought from Santiago del Estero, and a considerable mileage of railroad depends upon sugar for its freight. The province of Tucuman is the most densely populated in the country,† and furnishes a market for wheat and corn from Santa Fé, alfalfa from Cordova, wine from Mendoza, and cattle from Jujuy and Salta.‡ In recent years the sugar industry has passed through a crisis due to over-production (for the home market) and the necessity of selling a surplus abroad in competition with European bounty sugar. The result has been the organization of the manufacturers, who have succeeded in controlling the prices and limiting the production nearly to the demands of the country.§

The wine industry has made an advance similar to that of sugar. The grape grows throughout the central part of the country, both east and west. The humidity and heat of parts of Buenos Aires cause disease, but the vine does well in Entre Rios, in the south, in the new settlements on the Rio Negro, and in the west. It is

*The cane in Tucuman yields 7–8% sugar; in Mauritius, 18–19%; in Mexico, 18–19%. The sugar yield per hectare (2½ acres) is 2 tons in Tucuman, 3 tons in Natal, 4 tons in Egypt, 5 tons in Louisiana, and none of the latter countries is especially favoured for sugar production. Annales de Géographie, p. 255.

† In 1900 the population per square mile was 27.9 in Tucuman, 9.6 in Buenos Aires, 10.5 in Santa Fé, 11.9 in Entre Rios, 8.5 in Corrientes.

‡ Annales de Géographie, p. 255.

§ Annales de Géographie, No. 57, p. 256.

only in the dry and stony slopes of the Andes in the provinces of Mendoza* and San Juan that wine-making is extensively carried on, and here irrigation is a necessity.

In 1895, 71,000 acres were in vines. There have been extensions since that date, and the heavy wine importations of 20 years ago have been reduced to less than 20% of their former volume, and consist of the finer grades that cannot be grown at home. Nevertheless, Argentina wine production leaves much to be desired. The wine does not have good keeping or shipping qualities. The manufacturing plants are not of the best pattern, and the lack of refrigerating apparatus makes it impossible to control the temperature and regulate the fermentation. The vines are usually of French varieties and ripen their fruit much too early, necessitating the making of wine in the period of greatest heat. These difficulties are greater in San Juan than in Mendoza, because the cooler climate in the latter lets the vines remain dormant longer in the spring.

The early ripening of the fruit can only be remedied by the introduction of new varieties adapted to the climate. It is even possible that the desired varieties may have to be developed in the country, as they were in the eastern part of the United States. Under any conditions the replacing of the old vines with new will be a slow process, as it means the loss of income for several years. The successful development of a wine export trade seems to await these improvements in varieties and refrigeration.† In the meantime the only wines imported are some of the high-priced European specialties.

The irrigated region of the west is also the scene of a rising fruit industry somewhat similar to that of California. The natural conditions for drying fruit are excellent, and some grades are already grown in quantities sufficient for the home demand. In 1895 the raisin production was 10,582 tons.

Transportation and Population.—The extent of railroad development is one of the best indices of the development of an agricultural country. In this respect Argentina is far behind the western half of the Missouri-Mississippi Valley. This part of the United States has over 40,000 miles of railway, the whole of the

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* Mendoza has 60,000 acres in vines, and produced over 26 million gallons of wine in 1901. Bulletin of Bureau of American Republics, October 1901, p. 676.

† Annales de Géographie, p. 257.

Argentine 10,213,* but 200 miles more than the combined mileage of the State of Kansas and the Indian Territory.

The distribution of the Argentine railways reflects the industrial development of the different parts of the country. There is something of a network in the grain-growing region of the east and in the sugar districts of Tucuman, while long lines reach across the plains to the distant western settlements. The Government encourages immigration and agriculture, and there are extensive railroad plans for the future, including three lines across the Andes; as yet the first line, from Mendoza to Santiago in Chile, requires a difficult tunnel to complete it. The Government owns 1,200 miles of unprofitable railway, and all the other lines are owned by English capitalists.

The Parana River is navigable to the northern boundary of the country and is an important commercial highway. The Rio Colorado, in the southern frontier region, has also been found to be navigable for 300 miles. The Parana is navigable for ocean steamers as far as the port of Rosario (population 112,461 in 1900). The river is deep, and vessels can load directly from the warehouses upon the shore. The location of this port near the agricultural centre is such that the city must acquire an increasing importance in the export of agricultural commodities. The shipments of this class of articles amounted to 900,000 tons in 1901.

At the southern end of the agricultural region the Bahia Blanca reaches far inland, and at its head is the port of Bahia Blanca, a railway centre now rising into commercial importance, and having a promising future as the outlet for the pastures and grain fields of the southwest. Buenos Aires, the largest city among the Latin races, is the metropolis, the greatest market, and it therefore continues to be the predominant port for imports and the leader in exports, although the harbor is naturally very shallow.

The Argentine population numbered 3,954,911 in the census of 1895; and in 1900 the estimated number was 4,749,149. The increase was general throughout the country, except in the northeastern territory of Misiones, where there was a slight decline. The city and province of Buenos Aires increased one-quarter, the province of Santa Fé one-third, the newly-opened territory of Pampa nearly doubled, and the few hundreds in Tierra del Fuego were increased four-fold. The total population equals that of

* Figures for the end of 1901. Bulletin of Bureau of American Republics, March, 1902, p. 571.

Kansas, Nebraska, and the part of Missouri * lying to the south-west of the Missouri River. The Argentine population is a mixture of the three Latin races of Europe, with some Indian blood, but the proportion of Caucasian is far greater than in any of the tropic countries of South America. Since wool-growing became profitable in the middle of the nineteenth century there has been a considerable European immigration, chiefly from south Europe. From 1895 to 1900, inclusive, the arrivals ranged from 84,000 to 135,000 per year; but the unsettled character of the population is shown by the returning immigrants, who numbered during the same period from 37,000 to 62,000 per year, leaving the average annual gain by immigration during the six years 55,852. In 1895, of the foreign-born population 500,000 were Italians, 200,000 Spanish, 100,000 French, 22,000 English, 15,000 Swiss, 17,000 Germans, 13,000 Austrians.

ON THE NORTH WEST PASSAGE AND THE CIRCUMNAVIGATION OF AMERICA.

BY

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Early Arctic exploration was nearly always undertaken in the interest of commercial affairs. Scientific work, though extensively conducted, was almost always a secondary consideration; very especially was this the case in the many attempts to make the North West Passage.

Interest in the natural sciences has greatly influenced a tendency toward strictly scientific work, and most expeditions fitted out in recent years for exploration in the Arctic have made scientific work their first and most important object, and of such popular interest has this work become that it is doubtful if an expedition for any other purpose could find support.

Expeditions in the interest of science ever have been and will be largely directed by those who prosecute the work rather than by the people who support it.

Rarely, if ever, do the supporters of such work really dictate where and how it must be performed. This is easily understood when we take into consideration that such an expedition is gene-

* Estimated at 2,000,000.

rally headed by some one whose efforts have influenced support in the undertaking that he advocates and the work which he is ambitious to prosecute—often a work to which he has already devoted years of labour and study. If the theory and work as outlined inspire the confidence and sympathy of the public, and they support it, they virtually support him, believing that in so doing they support a worthy enterprise, and that in this way they assist in giving to the world a very great deal of good. The nearest approach to any general and systematic work in the interest of science yet conducted in the Arctic was in the establishing of the International Polar Stations, 1881–3.

No thorough and systematic research has ever been undertaken by any nation, people, or society for the purpose of an extended series of explorations. Thus it is that some sections are being traversed year after year, until there is not a stone left unturned; while others, large in area, rich in animal and plant life, inhabited by interesting races of people, geologically and otherwise important and entirely accessible, are completely overlooked.

In the supporting of natural science work, in the founding of great schools and other institutions of public interest, it can be said to the credit of many of our wealthiest men and women that they are building to themselves monuments that are imperishable, and that will be visible to a world, not a neighbourhood.

While the circumstances under which such work is done prohibit the possibility of systematic research in a general way, as the work of each and every expedition is generally conducted on a basis independent of that of any other, and while too many of these expeditions follow in the paths of predecessors, often influenced by an interest created by public sentiment, or, more likely, a desire to pass beyond the limits of their predecessors, yet there are those interested in such work whose independence of spirit and thought will lead them into the much-neglected regions purely for the good to be accomplished in the bringing to light new and rare material, and the final result must be the same.

I advocate the circumnavigation of North America because northern North America comprises a very great area of country, the most neglected of any in the Arctic; because it contains more of real interest to the natural sciences per square mile than any other part of the Arctic; because more and better work can be performed there for the cost than in any part of the Arctic; because there is more real new material to be gathered there than in any part of the Arctic.

To do this work would really involve the making of the North West Passage. But the one great object should be the acquisition of a vast and all-important fund of scientific data, the extent and value of which should far surpass that which it is possible to obtain now from any other part of the Arctic. The field is a great one; it is accessible; it will be worked, and through this work its advocates, supporters, and executors will be made known throughout the world.

Some of the most prominent efforts to make the North West Passage have been,

From the East:

That of John Ross and Lieut W. E. Parry, in the *Isabella* and *Alexander*, in 1818;

W. E. Parry with the *Hecla* and *Griper*, 1819–20; W. E. Parry in the *Fury*, and Capt. Geo. F. Lyon in the *Hecla*, 1821–2–3; W. E. Parry, in command of the *Hecla* and the *Fury*, 1824–5;

John Ross in the *Victory*, 1829–30–32–33; Sir Geo. Back in the *Terror*, 1836–7; Sir John Franklin, commanding the *Erebus* and *Terror*, 1845.

From the West:

That of Capt. James Cook in the *Resolution*, and Capt. Clerke in the *Discovery*, 1778; Beechey, 1826; Franklin search from the west, Capt. Richard Collinson in the *Enterprise*, Capt. Robt. McClure in the *Investigator*, 1850–1–2–3–4–5.

With the loss of the Franklin party of one hundred and twenty-nine souls ended all attempts at making the North West Passage. For fifty years all interest in the North West Passage has been smouldering, and all interest in the great stretch of coast and islands at the north of our continent, with its wealth of natural history resources, has been buried. People, like sheep, follow a leader; some day this work will be resumed, and all the nations of the civilized world will be aflame with interest.

Every one of these expeditions was sent from England, and, although much good came to science through their efforts, they were prompted largely by commercial enterprise. That these expeditions should have failed in their main object is not strange.

That the circumnavigation of America can and will be accomplished is quite plain. Neither Cook nor Beechey ever reached Pt. Barrow, but the whalers, even in sailing vessels, now pass around it and far to the east every year.

The expedition that circumnavigates America and makes the North West Passage will rival the honours of the expedition that

reaches the North Pole, and would far surpass all Arctic expeditions of modern times in its scientific results.

In order to create an interest in any scientific expedition, that expedition must have a well-defined purpose, and that purpose must be one that appeals to the most intellectual and learned people.

Very little effort has ever been made by America or by Americans in the exploration of northern North America, and very little credit is due them for what knowledge we have of this great region.

I believe that an American expedition can and should do what those from Europe have failed in their attempts to do.

I believe that it is highly important that Americans should make complete investigations of the geographical and natural history resources of their own country. I believe that such an undertaking, rightly presented, would find a warm place in the hearts of the best American people, and would not be lacking in support. I favour an all-American expedition, and I would, for many reasons, favour private rather than public patronage.

The members of the expedition should be English-speaking, American-born. Men for every position, from the coal stoker up, should be selected with precise and careful consideration for their fitness for the work demanded by their position, and their capability to withstand the deprivations likely to be encountered.

The man in charge of the expedition should be a man of resources, and perfectly familiar with the physical conditions to be encountered in such a country. He should be familiar with every kind of travel in such a country. He should know what is possible to accomplish and what is not. He should be a man of experience, in the prime of life, and capable of great endurance. He should be a man capable of inspiring his party with courage, of knowing their needs, and of so managing the affairs of the expedition in general as to make possible the accomplishment of the best results from the scientific corps. He should be familiar with the country to be travelled and capable of withdrawing his party to a place of safety in case of accident, to prevent the useless loss of life that so often occurs.

He should have a knowledge of the proper foods and proper clothing and of the equipment of sledding parties and what to expect of them. He should understand how to keep his party active and know the essential features in keeping them healthy and in good spirits.

Under him should be the navigator of the ship. The navigator of the ship should be a man of strong physique, in every way a

thorough and capable navigator, and one who has had extended experience in ice navigation. He should know ice as a mathematician knows figures, and be thoroughly conversant, not only with the working of the ship through fields of ice, but with putting it into and getting it out of the winter quarters. He should have the supervision of the crew—strong, hardy young men, selected from the crews of whaling ships, accustomed to wintering in the Arctic.

Geographical, meteorological, geological, zoological, botanical, and ethnological work in all various departments of their respective branches should each be under the direction of a competent man fitted for such work, and all should be aided in extending their research by the head of the expedition.

Eskimos could be used to good advantage throughout the entire north coast.

An expedition leaving for such an undertaking should be fitted for three to five years' stay.

GEOGRAPHY AND INTERNATIONAL BOUNDARIES.

BY

ISRAEL C. RUSSELL.

The recent bitter controversy between the Argentine Republic and Chile concerning the position of the boundary between their respective territories, the long-continued contention between Great Britain and Venezuela in reference to a similar question, and the still pending discussion as to the meaning of a treaty between Great Britain and Russia, in which the position of a portion of the line of demarcation between Alaska and Canada is involved, furnish instructive lessons in reference to the importance of geographical knowledge on the part of statesmen and diplomats charged with the responsibility of framing international treaties involving the partitioning of land.

The international boundary disputes, just referred to, as is well known, are but recent examples from a long category of similar misfortunes, embracing all historic time, and not infrequently including disastrous wars, as well as heated discussions and lengthy arbitrations. The study of the history of this group of international troubles should show what the germ of the disease is, and how similar disorders may be avoided in the future.

The principles involved in large real estate transfers—for such the acquiring of a title to land by a nation may be justly termed—are fundamentally not different from those controlling the dividing of a farm among the heirs of its former owner, or the sale of a city lot by one man to another. Indeed, the legal contests and the too frequent disputes, with mutual defiance of law, between individuals in reference to property lines, have their counterpart on a larger scale and involving correspondingly greater disasters, in the boundary disputes between nations. The experience gained in the smaller dealings may reasonably be expected to furnish guiding principles for safely transacting the larger business. The most important parts of an ordinary sale of land, in addition to the payment of the stipulated price, are: a search of its title, a survey of its boundaries and the making of them on the ground, together with an accurate description of them in a deed and in many instances on a map, and the official recording of the deed and perhaps also of the map. It is to plain, straightforward real estate transfers of this nature that we hope, if we do not believe, nations are tending, and other and more complex phases of national expansion need not be considered at this time.

In the transfer of the title to land from one individual to another the services of a lawyer and of a surveyor are important, and one is as essential as the other. In the transfer of territory from one nation to another the diplomat—that is, the acute and learned state lawyer—scrutinizes the title of the territory in question from all points of view involving international laws and customs, but the services of the surveyor of broad training and wide experience, or the *geographer*, are much less commonly secured during either the preliminary negotiation leading up to a transfer of territory or the final drafting of a deed to it in the form of a treaty. It is a significant fact, however, that in connection with several of the lengthy disputes and arbitrations concerning treaty boundaries that have arisen, owing to a lack of geographical knowledge on the part of the diplomats who made them, extensive compilations of maps and even detailed surveys of large portions of the earth's surface have been made. Still further arguments might be presented, did space permit, to show that the co-operation of diplomats and geographers is as essential in national transfers of territory as the combined labours of lawyers and surveyors in order to secure a perfect title to land sold by one individual to another.

It is not only important that international boundaries should be

described in precise terms, accurately located, easy of identification, and capable of being re-located in case the monuments employed to mark their courses become obscured, but also highly desirable that the best geographical boundaries within the range of choice should be selected before a final interchange of treaties is made. By the best geographical boundary is meant the one which secures the most advantageous adjustment between the activities of men and natural conditions. It is in the adjustment of boundaries to physiographical conditions, as well as in the actual survey and location of them on the ground and on maps, that the geographer may be of service to the state. The history of boundary disputes indicates only too clearly that the negotiations between nations respecting the transfer of territory from one flag to another have in many instances been entrusted to diplomats solely, and geographers not consulted. The dividing lines between nations have not infrequently been described in a few general paragraphs at Ghent, Paris, or Washington by diplomats who, so far as can be judged from the treaties they signed, had but slight knowledge of the geography and resources of the lands through which the boundaries were to run, made no attempt to select the best from the several lines that might have been considered, were not influenced by a desire to adjust the proposed boundary to natural conditions in such a way as to secure the maximum advantages to commerce, etc., of the nations immediately concerned, and gave no heed to the relative merits of the several classes into which boundary lines may be divided.

The first step in an endeavour so to adjust boundary lines to physiographical and political conditions, that the least detriment to the abutting nations shall result, is to classify boundaries and study the merits of the several groups into which they naturally fall.

The boundaries between nations, states, provinces, etc., established in various ways, may be classified, at least provisionally, in six groups. We may term these groups *coast boundaries*, *astronomical boundaries*, *water boundaries*, *mountain boundaries*, *divide boundaries*, and *arbitrary boundaries.*

Coast Boundaries.—The junction of the sea and land on the borders of continents and islands furnishes natural and clearly-defined lines, which are evidently the most desirable of any of the various classes of boundaries for defining political limits. By international consent the jurisdiction of a country bordering on the "high

seas" is a line one marine league seaward from the margin of the land, and following its meanders. As an international dividing line the one league limit seldom, if ever, becomes important, since the nice adjustment of the width of an arm of the sea necessary for such a purpose rarely occurs. When an extension of the ocean's waters, intervening between two nations, is less than two marine leagues wide the boundary between them commonly follows its medial line, and has all the essential features of a water boundary, described below.

Astronomical Boundaries.—The shape of the earth and its motions in reference to the sun are such that certain imaginary lines on its surface may be located with precision by astronomers, and if the monuments or other marks employed to show the positions of such lines are removed they can be accurately re-located. The lines referred to are principally parallels of latitude and meridians of longitude, and boundaries, so far as they coincide with these lines, may for convenience be classed as astronomical boundaries.

Examples of the class of boundaries here indicated are furnished by the one defining the east border of the main body of Alaska, which, as defined in a treaty made in 1825 between Great Britain and Russia, is the 141st meridian west of Greenwich; and by the boundary between Canada and the continental portion of the United States from near the Lake of the Woods westward to the coast of the continent, which, as finally decided in a treaty between Great Britain and the United States in 1846, is the 49th parallel of north latitude. The boundaries of a number of the States of the United States, and of several of the Provinces of Canada, are either wholly or in part parallels of latitude or meridians of longitude, and furnish good examples of what are here termed astronomical boundaries.

The most conspicuous advantages of astronomical boundaries are that they may be accurately described without a knowledge of the country through which they pass. They can be located with precision and their courses accurately marked by monuments. For these reasons astronomical boundaries, when clearly defined in treaties between nations or in laws concerning the territorial limits of states or provinces, leave no room for contention as to their positions.

The leading objections to the use of astronomical boundaries, particularly as international dividing lines, are: The temptation they offer to diplomats and others, who may be interested in the

speedy conclusion of a treaty, to make hasty divisions of territory without knowing its resources or commercial and other possibilities. Then, too, such boundaries cross the land without reference to its topography, and have no essential relations to the courses of streams or the directions of coast lines, etc. They may divide a fruitful valley in a most arbitrary and inconvenient manner between two nations with widely-different laws and customs, or cross a navigable river at several localities, and intersect a coast or lake shore so as to initiate complex conditions in respect to harbors, navigation, customs duties, etc. In these and still other ways boundaries coinciding with lines of latitude and longitude are apt to bring about detrimental commercial and other relations between adjacent nations, states, and provinces. A region which is an industrial unit—as the gold fields of the Klondike district, the iron-bearing tracts to the west of Lake Superior, the wheat lands of the Red River valley, the forested lands of the North West coast, etc.—when divided between two or more countries with different laws, is deprived of the advantages that should follow from the natural course of industrial development, and one part or the other suffers in consequence.

Again, until an astronomical boundary is surveyed and marked on the ground by skilled geodesists, it cannot be located even approximately by miners, trappers, foresters, and others, and many difficulties are apt to arise in this connection.

Although an astronomical boundary once decided on and formally recorded in a treaty leaves no excuse for national quarrels as to its position, it is evident that its far-reaching and perhaps highly-complex influences on the development of neighbouring peoples are likely to be such that the natural resources, conditions affecting transportation, etc., of the region through which it passes should be thoroughly understood before a final decision is reached.

Water Boundaries.—In numerous instances the medial line or one shore of a stream, lake, estuary, strait, or other water body not recognized as a part of the "high seas" has been selected to serve as a fence between nations and states; collectively, such dividing lines, typically represented by a river without islands, flowing between well-defined and permanent banks, may conveniently be termed water boundaries. In general, when a stream, lake, etc., is a national or state boundary, its medial line, or the centre of the main channel when there is more than one, is defined as the precise line of demarcation.

The leading features of water boundaries are illustrated by a portion of the line separating the United States from Canada, which traverses the middle of the St. Lawrence River, and divides medially several of the Great Lakes and their connecting streams. The south boundary of the United States is also in part a water boundary, and is defined by treaty as "the middle line of the Rio Grande, or its deepest channel where there is more than one."

In certain instances, when a river, lake, bay, etc., separates two political organizations, one shore or the other may be defined by treaty or by law as the actual line of separation, and even complex relations may exist, in reference to jurisdiction over the dividing waters. The water boundary between New York and New Jersey, for example, is, in part, the middle line of the Hudson and of New York Bay, etc., with several qualifications, including exclusive jurisdiction by New York over the waters of the Hudson to the west of Manhattan Island to the low water line on the New Jersey shore, subject, however, to certain rights of property and of jurisdiction of the State of New Jersey, etc.. The waters of Delaware River are by agreement between New Jersey and Pennsylvania a common highway, over which each State "shall enjoy and exercise a concurrent jurisdiction within and upon the water, and not upon the dry land between the shores of said river"*; the islands in the river being specifically assigned to the one or the other State.

The advantages of a water boundary are suggested by the fact that in most instances they may be easily located, even by persons inexperienced in the method of surveying. Coinciding, as they generally do, with definite geographical divisions, they do not lead in a conspicuous manner to complications in the industrial development of the countries or states separated by them.

The difficulties to which water boundaries may give rise are indicated by the fact that streams, more particularly than the other water bodies in question, frequently divide so as to enclose islands, and in certain instances on nearing the sea send off, perhaps, several distributaries, which discharge through independent mouths. When a stream divides so as to enclose an island, even if the main or the deeper channel is specified by treaty or by law, as the one chosen as a boundary, the question as to which of two channels is really the larger or the deeper may not permit of definite answer. Streams are subject to many changes, and what is the main channel

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* Henry Gannett. *Boundaries of the United States and of the several States and Territories.* U. S. Geological Survey, Bulletin No. 171, second edition, Washington, 1900.

one year may become of secondary rank the next year, or a river, as not infrequently happens, may shift its course bodily, and thus furnish grounds for contention as to the ownership of the territory transferred from one of its banks to the other. The distributaries of streams, or the separate channels into which they divide on deltas, etc., are also subject to conspicuous and sometimes sudden changes. Who could decide, for instance, which is the main channel of such rivers as the Mississippi, the Nile, or the Ganges, in the delta portions of their courses; or if a choice seemed practicable, is there any assurance that the distributary, largest to-day, will maintain its supremacy for a decade to come, or even be in existence a century hence?

The controversies that may arise in reference to which of two channels in a designated water-body is the main one, are illustrated by the well-known "San Juan episode," which came near bringing on hostilities between Great Britain and the United States in reference to the ownership of certain islands in the Strait of Georgia; the immediate subject of contention being whether "the channel which separates the continent from Vancouver's Island," as the statement reads in the Webster-Ashburton treaty, 1846, passes to the east or to the west of the San Juan Islands. The Emperor of Germany, as is well known, acting as arbitrator, decided that the islands belong to the United States. Thus, in 1872, a series of disputes as to the Canadian-United States boundary, which had been carried on for ninety years, was closed.

While water boundaries and especially rivers, in certain instances, have furnished almost ideal dividing lines between nations, in other instances they have proved to be objectionable. The difference lies in the nature of the streams themselves, and illustrates the fact that, with water boundaries as with other classes of dividing lines between nations, a critical knowledge of the geography of the region through which they pass is a pre-requisite of treaty-making, if subsequent boundary disputes are to be avoided.

Mountain Boundaries.—The crests of mountain ranges, or mountain chains, are sometimes specified in treaties as defining territorial limits. The ideal mountain range is one having a generally straight alignment and a continuous and sharply-defined crest, but in nature this ideal is seldom attained. Modern geographical studies have shown that many so-called mountains, which from a distance appear to be well-defined uplifts with sharp crest-lines,

are in reality broad plateaus or great domes, deeply dissected by stream erosion. In such instances it is frequently difficult to decide where the crest of the range is located. Indeed, as is not infrequently the case, there is no definite and tangible crest-line. Although it is sometimes assumed that the crest-line coincides with the water parting, or the divide, between the head-branches of streams flowing in opposite directions from a mountain-like uplift, it is well known that a mountain range, even when bold and sharply defined, may not be a divide for the principal streams of the region where it is situated. An illustration in point is furnished by the Appalachian Mountains, through which the Susquehanna, Delaware, and other important rivers rising in the plateau to the west flow transversely in deep valleys and empty into the Atlantic.

The recent controversy between Argentina and Chile was due to an assumption in a treaty between them that the crest-line of the Southern Andes coincides with the water-parting between the streams flowing to the Atlantic and those discharging into the Pacific. Post-treaty surveys, as they may suggestively be termed, have shown that in the portion of the Andes in question streams rising well to the east of the mountains flow westward through them in deep transverse cañons, and that there is a wide discrepancy between the continental water-parting and the topographic crest-line of the continent.

A mountain boundary, if defined as the line along which the upward slopes on the opposite sides of a prominent uplift meet in its summit portion, would in most instances be irregular and perhaps conspicuously intricate, for the reason that mountain crests are modified and shaped by erosion and migrate in one direction or another according to the strength and other qualifying conditions of the opposite-flowing streams. Then, too, an uplift which seems to a casual observer to be a single mountain range may, in reality, be highly complex, and no continuous crest-line be discoverable. In short, the sweeping statements sometimes embodied in treaties, to the effect that the line of demarcation between contiguous countries shall be the crest-line of a certain indicated mountain range are fraught with uncertainties and difficulties, which are likely to prove a source of discontent and costly arbitration, or even lead to war.

Divide Boundaries.—A boundary which is defined as following a specified water-parting or divide, from which streams flow in opposite directions, would in most instances be easily traceable on the ground even by persons unskilled in the art of surveying, and

for this and other reasons has much to commend it; yet, without an accurate knowledge and, most of all, an accurate topographic map of the region through which such a boundary is to pass, its selection on general principles, however nicely worded, is open to dangers of the same nature as those pertaining to a similar choice of a mountain boundary.

In arid regions broad plateaus may form divides, and even an approximate location of the line of water-parting, if one exists, be a matter of difficulty and uncertainty. Then, too, the process of head-water corrasion pertaining to essentially all streams, and of stream capture, or the acquiring by one stream, through the process of stream development, of the territory formerly drained by its neighbour, leads to a migration and sometimes a sudden and perhaps extensive shifting of a water-parting.

Examples of divide boundaries are furnished by the one separating Idaho and Montana, which in part coincides with the continental divide, and serves its purpose well; but the satisfaction it has given is to be qualified by the fact that, for the most part, it is situated in a rugged region, where there is but slight probability of the property interests of the communities parted by it coming into direct contact.

Boundaries which are made to coincide with the courses of rivers, with the crest lines of mountains, or with water-partings, have certain commendable features in common; they are easily located, readily defined by natural features of the earth's surface, and in general do not require to be accurately surveyed and marked by monuments before they serve their purpose as international or inter-state fences.

Arbitrary Boundaries.—A class of boundaries not otherwise readily definable may be conveniently designated as arbitrary boundaries, since, as a rule, they are not described in terms such as pertain to astronomical boundaries, and bear no necessary relation to topographic or other features of the regions they traverse. Like astronomical boundaries, the ones here considered are imaginary lines, and, in part, might with propriety be included in that class, since they are capable of being located by astronomical methods; but they serve our purpose better if considered in a group by themselves. The class of boundaries here referred to includes straight lines connecting two points; lines defined as running in a given direction (azimuth) and for certain distances; arcs of circles; tangents to circles, etc. In brief, arbitrary boundaries may be de-

fined as straight or curved lines or combinations of such lines, and are similar to the lines employed by surveyors in marking the boundaries of a farm, locating a railroad, etc.

An example of what is meant by an arbitrary boundary is furnished by the line separating Delaware from Pennsylvania, which is an arc of a circle twelve miles in radius, with the steeple of the old court-house in Newcastle, Delaware, as a centre. Again, in the establishment of the District of Columbia, a rectangle ten miles square was chosen and marked on the ground by means of monuments as the site of the capital of the United States. Another illustration is furnished by the eastern boundary of California, as defined in its constitution. This boundary runs from the intersection of 120 degrees of west longitude with the 39th degree of north latitude, in a straight line in a southeasterly direction to the River Colorado, at a point where it intersects the 35th degree of north latitude.

Boundaries of the nature just cited can only be recognized when actually marked on the ground, and except in the case of straight lines, not of great length, or small geometrical figures, are difficult of precise location, even by skilled surveyors. Should the monuments used to define their positions be destroyed, their replacement is an arduous task.

Impracticable Boundaries.—There are certain dividing lines which are defined in treaties, decrees, etc., as running parallel to some natural feature, as a coast or a river, and at a given distance from it, that might with propriety be classed as arbitrary boundaries, since no effort is made to adjust them to the natural conditions of the immediate territory they traverse; but, for the purpose of expressing a still greater weakness inherent in them, they are here specially designated as *impracticable boundaries.* This, as is to be hoped, temporary class of boundaries includes the proposed lines of demarcation sometimes inserted in treaties, etc., which it is impossible, or at least impracticable, without great and, for the most part, useless expense of time and money, to mark on the ground, and thus seek to make serviceable.

In this connection reference may be made to the boundary between southeastern Alaska and Canada, which, as stated in the treaty between Great Britain and Russia previously referred to, in the absence of a mountain range parallel with the coast and not over ten marine leagues inland—and as subsequent explorations and surveys have shown such is the case—"shall be formed by a

line parallel to the windings of the coast, and which shall never exceed the distance of ten marine leagues therefrom." The region through which the line described would pass, if surveyed, was almost entirely unknown at the time the treaty referred to was made, but, as has since been discovered, it is exceedingly rugged, and contains many mountains, ranging from 10,000 to 18,000 feet high, besides a multitude of glaciers and many extensive fields of perpetual snow. To survey and mark on the ground the boundary indicated in the treaty would be what may be justly termed an impossible task; and, besides, if the line as defined by treaty should be established, it would be intricate, and much less serviceable as a national fence than any one of several possible boundaries that could have been chosen, with essentially the same end in view, at the time the original treaty was entered into, had a geographer been employed to make even a hasty reconnoissance of the region in question.

Another example of a boundary being defined as running parallel to and at a specified distance from an irregular geographical feature, is furnished by a part of the boundary between Massachusetts and New Hampshire, which is a line parallel to Merrimac River, and distant from it three miles on the north. In this case, although the distance of the line designated from the one to which it is to be drawn parallel is but three miles, and the country between only mildly undulating or hilly, the boundary as now marked on the ground and accepted as an interstate boundary, is but a rude approximation to the one originally defined.

These examples, and others that might with propriety be classified as impracticable boundaries, illustrate again the desirability of accurate geographical knowledge, and still more of an adequate appreciation of the difficulties and limitations met with by the surveyor, on the part of those who attend to the real estate business of nations.

The reader will perhaps ask, now that we have something of the relative merits of the various classes of boundary lines before us, which class is best and what kind of a boundary should be chosen in case new treaties involving a transfer of territory from one nation to another become necessary. The reply is, that such a choice must be determined by the conditions met with in individual cases, the prime requisite being an accurate knowledge of the geography, natural resources, and commercial advantages of the territory to be divided. These data should be in the hands of the

agents of the nations participating in the transaction, and, to a great extent, can best be presented on topographic maps.

While it is not to be expected that the entire earth can be subdivided among nations on strictly geographical principles, making each international boundary coincide with a strongly pronounced topographic feature, and assigning to each political division a definite geographical unit, as, for example, an entire continent, or island, or a definite river system, or drainage slope; yet, in many instances, as the history of boundaries shows, there have been opportunities to make at least some adjustment of political to natural divisions, and other opportunities in the same direction will, no doubt, recur in the future. In locating a railroad or other similar task preliminary surveys of several possible lines are usually made, and their relative advantages compared, before a final route is chosen; logically, it is still more important that an international boundary should represent the net result of several trial surveys, in order that the best possible line under the prescribed political and social limitations in each case may be discovered. If circumstances dictate that an international boundary is to be agreed upon, which intersects a new country, of which no reliable maps are available and trial surveys are debarred, it is plainly apparent, from the relative merits of the various classes of boundary lines, that either an astronomical or an arbitrary boundary, or a combination of the two, should be chosen, if all danger of future broils is to be avoided. Under the conditions referred to, it is apparent that a purely astronomical boundary will best serve the desired purpose. With an accurate topographical map of a region which is to be divided, in hand, trial surveys can be made on it as well in many ways, as if they were actually traced on the ground; but, in addition, the geological and other resources of the region need to be known. With all of this essential information available, the final choice of a definite boundary would be regulated by a large number of local conditions, and a composite boundary, adjusted throughout to natural conditions, would probably be found to serve the desired end most efficiently.

The services of geographers in connection with boundary treaties, pertaining particularly to new regions of the earth, should not be considered simply as a means of perfecting titles and of removing grounds for future disputes, highly desirable as such aims manifestly are, but in order that the best possible adjustment of natural resources, avenues of interior communication, and accessibility to the ocean highways of commerce may be secured to each

of the parts into which a given territory is divided. A just and reasonable adjustment of boundaries involves something more than the consideration of square miles of territory, since the intellectual and commercial development, not only of the adjacent nations but of all mankind for perhaps many centuries, is involved therein. It may perhaps be urged in opposition to this imperfectly stated, but, as is intended, broad and fraternal view of international relations, that the greed of nations for territory renders the services of the geographer unnecessary to the framers of treaties, except so far as they remove grounds for dispute—and perhaps not even then, since an aggressive nation may design to involve its neighbours in fresh controversies. Admitting that greed is the controlling principle in international transactions, and will no doubt continue to be so until the earth has been rendered uninhabitable by reason thereof, it is still just to claim that the more fully the participants in a struggle for territory are mutually informed in reference to its present and future values, the more nearly will a reasonable adjustment of its boundaries to natural conditions be secured.

HYDROLOGIC AND HYDROGRAPHIC SURVEYS OF THE UNITED STATES.

As a result of the creation of the new reclamation service under the United States Geological Survey to construct canals, reservoirs, and affiliated works for the irrigation of the public lands of the arid regions of the West, the hydrographic branch of that bureau has been reorganized. As constituted it consists of three principal divisions—namely, hydrography, hydrology, and reclamation surveys, all under the chief engineer, Mr. Frederick Haynes Newell. In bringing about this reorganization the words *hydrography* and *hydrology* have received a special and more limited meaning. Like geography and geology (the latter of which is a special outgrowth of the former, and has to do with the underground geography of the earth's surface), so the name hydrology has been adopted as implying a study of the underground water resources, as distinguished from hydrography, which term is limited to apply to the surface water supplies and sources.

The hydrographic division of the Geological Survey is devoting

its energies to the measurement of the discharge of the various streams of the country, and to a study of the rainfall on the drainage basins of these streams and of their areas, with a view to ascertaining their probable maxima, minima, and average discharge. In the western or arid regions the results of this work will be of immediate use to the engineers having charge of the planning of the Government irrigation works, and in consequence the supervision of the hydrographic work is in most instances vested in the reclamation engineers. In the Eastern States the results of this study are of immediate value to cities seeking additional water supply and to mill owners and others looking for water power. The investigations are accordingly placed under a number of local or resident hydrographers, and are administered from the central office in Washington.

The new division of hydrology has two separate sections. In the western, extensive investigations are being conducted to ascertain the possibilities of developing underground waters for use in irrigation. This investigation includes a careful study of the geologic structure of the regions under examination from which to obtain the basis for prediction of the location and quantity of subsurface water supplies. Among other purposes, this investigation is expected to indicate where experimental wells, which are provided for under the Reclamation Act, may be sunk. Some sites for such wells have already been selected. Deep wells may be bored for artesian supplies, and galleries or tunnels mined into the water-bearing gravel of the dry streams. In the eastern section similar investigations are being carried on with a view to developing underground water supplies, chiefly for the purpose of domestic and city water supply.

In view of the nature of the investigations to be made, the work has been placed under the immediate supervision and control of geologists; the eastern section under Mr. M. Fuller, and the western under Mr. N. H. Darton.

The eastern section has been divided into about 25 districts, locally managed, in large part, through co-operation with State or college geologists. At present the more important work in hand includes the collection of records of wells, including the amount of water supplied per unit of exposed area for open wells, and for drilled wells, their depth, and the nature of the formations bored. It is expected that the results will throw some light upon the occurrence of underground water, and the possible prediction of its existence in localities in which it is not now known.

In Maine this work is in progress under Prof. W. S. Bayley, of Colby University, chiefly with a view to determining the means of providing water for the summer resort islands. In New Hampshire Mr. Boutwell is conducting examinations with the same purpose in view, as are also Prof. Perkins, State Geologist, in Vermont, Prof. Crosby in Massachusetts and Rhode Island, and Mr. Gregory in Connecticut.

On Long Island more detailed investigations are in progress. These will be very complete, and will include systematic study of the geology and water resources of the entire island. The geologic investigations are under the direction of Mr. Fuller himself, and of Professor Hallock of Columbia University. Under the direction of Mr. Veatch about 1,000 borings will be made in co-operation with the Commission for Additional Water Supply for New York City, and samples of the borings will be recorded for every foot sunk. These will be carefully studied with a view to determining velocity, rate of flow, capillarity, and other physical properties. Professor Slichter of Madison, Wis., who has recently achieved such prominence through the skill which he has displayed in studying the theory and occurrence of underground water supplies, will make measures of the sub-surface flow of water between various wells with the aid of his electrical bridge.

In connection with these investigations the topographic branch of the United States Geological Survey, in co-operation with the State Engineer and Surveyor of New York, has just placed in the field a large force of surveyors under the general direction of Mr. H. M. Wilson, Geographer in charge, who proposes to complete the mapping of the remaining eastern half of Long Island. The resulting work will be published on seven atlas sheets, named: Moriches, River Head, Shelter Island, Sag Harbor, Gardiner Island, East Hampton, and Montauk Point. The force consists of two topographers, several levelmen, and a number of traversemen and field assistants. The whole area to be mapped is approximately 700 square miles, and upon the completion of this survey a small-scale wall map, about 2 miles to 1 inch and with contours of 20 feet interval, will be prepared and published, covering the whole island in one map sheet. This will furnish the basis upon which to complete the investigations of the geology and of the water supply, and will conclude one of the most thorough and systematic studies of the natural resources of a region made in any portion of the United States.

Elsewhere in the east investigations are in progress all along

the Atlantic coastal plain from New Jersey to Texas with a view to developing additional sub-surface sources of water supply. Finally, active field work is in progress in Missouri, Arkansas, Iowa, and Wisconsin. The eastern section of the hydrologic survey has already in preparation co-operative reports of the underground water resources of New Jersey by Mr. Knapp, of Georgia by Assistant State Geologist McCallie, of Alabama by State Geologist E. A. Smith, and of Nebraska by State Geologist Harris.

The western section of hydrology is equally active. In the neighbourhood of Mesa, Arizona, in the Salt River valley, investigations are being conducted by Mr. Lee in co-operation with the engineers of the reclamation service, who plan to add to the sub-surface water supplies. These investigations point to the possibility of increasing the water supply in the region for which water is most precious by the sinking of wells in the deep valley gravels. The efforts to pump some of the existing wells have shown their capacity to be far beyond what had been anticipated, and considerable areas are now under irrigation from steam-pumped wells. In Texas, investigations are in progress with a view to extending the important new artesian water basin recently developed along the coastal plain. In South Dakota, Professor Todd is adding to the information already possessed of the artesian water supplies in the James River valley. In North Dakota, Professor Williard, of the State Agricultural College, is conducting similar work. In Southern California, examination into the underground water supplies, particularly in the neighbourhood of Los Angeles, is being conducted under the direction of Mr. Lippincott, of the reclamation service. In Oregon Mr. Landis, and in Nebraska State Geologist Barber, are directing compilation of data and records of sunk and driven wells.

This section of the hydrologic survey has already in preparation reports of the geology and underground water prospects of the central plains region by N. H. Darton; also special reports on southeastern South Dakota by Professor Todd; on northeastern North Dakota by the late C. M. Hall, and on central New Mexico and Arizona by Mr. Darton.

COMPARISON OF DISTANCES BY THE ISTHMIAN CANAL AND OTHER ROUTES.

BY

EMORY R. JOHNSON.

In determining what commerce would use an isthmian canal, the fact of most fundamental importance is the effect which the new waterway will have on the ocean distances between the trade centres adjacent to the Atlantic, and those in and about the Pacific. The length of the route determines the time of the voyage, and, in general, the commerce of the world is so conducted as to minimize distances as much as the conditions of ocean navigation and international exchanges permit. Accordingly, a discussion of the traffic of an isthmian canal should be preceded by a comparison of the distances between the Atlantic and Pacific, by way of the American isthmus, with those by way of the various routes now followed. This comparison can best be made by means of a series of tables,* giving the distances by alternative routes between the most important commercial centres. In most respects the tables are self-interpretative. The distances are expressed in nautical miles, and the figures used in compiling the tables were furnished by the United States Hydrographic Office. The length of each canal is reckoned in nautical miles, the Nicaragua Canal being 161 nautical miles long, the Panama 41, and the Suez 88.

In the first table a comparison is made between the distances by the Nicaragua Canal with those by the Straits of Magellan between the Atlantic and Gulf seaboard of the United States and the west coast of North, Central, and South America. This table compares the distances by way of the Nicaragua Canal with those through the Straits of Magellan, from the chief ports of our Atlantic and Gulf seaboard, extending from Portland and Galveston to thirteen representative ports on the west coast of the American continents. Coronel, the most southerly of the west coast ports mentioned in the table, is situated within two or three hundred miles of the southern limits of the industrial section of Chile. It is also an important coaling port at the present time. It will be observed that the distance from New York to Coronel, by way of the Nicaragua Canal, is 3,069 miles less than the present route through the Straits of Magellan.

* Tables I–VIII on pages 169–176.

The effect of an isthmian canal upon the length of ocean routes, connecting our Eastern seaboard with the west coast of the three Americas, is well shown by comparing the distances by way of the Nicaragua Canal and the Straits of Magellan from New York, the largest Atlantic port, and from New Orleans, the largest Gulf port, to San Francisco, the representative west coast city of the United States; to Iquique, the centre of the nitrate of soda section; and to Coronel, in southern Chile. This comparison is shown in the following table:

	New York.		New Orleans.	
	VIA NICARAGUA.	VIA MAGELLAN.	VIA NICARAGUA.	VIA MAGELLAN.
San Francisco	4,921	13,714	4,118	14,114
Iquique	4,393	9,221	3,590	9,621
Coronel	5,161	8,230	4,358	8,360

In Table II the distances from representative European ports to the west coast of the American continents by the Nicaragua and Magellan routes are given.

The European ports included in Table II are so situated that the distances from them to Pacific ports typify the distances from the leading industrial and commercial centres of Europe. It will be observed that the distance from Liverpool to Coronel, by way of the Nicaragua Canal, will be 709 miles less than by the route through the Straits of Magellan. The route to the nitrate port of Iquique will be shortened 2,468 miles. San Francisco will be brought 6,433 miles nearer to Liverpool, and 5,780 miles nearer to Gibraltar.

In Tables III, IV and V the distances from the Atlantic American ports to Pacific countries, by way of a Nicaragua Canal and by way of existing routes, are compared.

In Table III the distances from representative ports of the Atlantic and Gulf to Yokohama, Shanghai, and Hong Kong by way of the various alternative routes are given. The distances given in the table are those which a vessel would take in going by actual commercial routes. It has been deemed more important to deal with distances by commercial routes rather than by the shortest possible course. The shortest route from the American isthmus to Japan or China is by way of the Great Circle. The distance from Brito to Yokohama direct is 7,122; via Magdalena Bay, Lower California, 7,144; via San Francisco, 7,236; and via Hono-

lulu, 7,610. By the Great Circle route a vessel can call at San Francisco by adding only 114 miles to its voyage; and with this call at San Francisco included, the distance from New York to Shanghai by the Great Circle and Yokohama is 374 miles less than via Honolulu and Yokohama. The Nicaragua route is shorter than the Suez route for all Asiatic points mentioned in the table, the advantages of the Nicaragua route being greater for our Gulf ports than for those on the Atlantic. Especial note may be made of the fact that the distance to Hong Kong by way of Honolulu, Guam, and Manila is considerably greater than by a route which enables a vessel to call en route at San Francisco, Yokohama, and Shanghai. The latter route is 536 miles less for a vessel starting from New York.

In order to compare the distances by various routes connecting our eastern seaboard with Manila, Table IV has been prepared.

It will be seen in the table that the distance from New York to Manila by way of San Francisco, the Great Circle and Yokohama is 11,207 miles, and that the distance by way of Honolulu and Guam is 11,274 miles. The Suez route is longer than either of these routes, being 11,601 miles. A vessel bound from New York or New Orleans, or any other Eastern seaport to Manila, can call at San Francisco, Yokohama, and Hong Kong en route by adding 720 miles to the length of a voyage by way of Honolulu and Guam. Manila, it will also be noticed, is somewhat nearer the eastern part of the United States by way of the Nicaragua Canal than by way of Suez.

The manner in which the Nicaragua Canal would affect the distances between our eastern seaboard and Australia is shown by Table V.

The distance from New York to Australia by the Cape of Good Hope is practically the same as by the Suez Canal, and the Cape route has the advantage of more favourable winds and currents and of a cooler temperature. Vessels going from our eastern coast to Australia always round the Cape; accordingly, the comparisons of Table V are between the Nicaragua and Good Hope routes. Steamers bound for Australia via the Cape usually call at St. Vincent for coal; hence the distances given in the table include a call at that island. The route between the American isthmus and Australia and New Zealand is by way of the centrally-located Island of Tahiti, which may become an important coaling station upon the opening of the Isthmian Canal.

New York is 3,982 miles nearer Sydney by way of Brito and

Tahiti than via St. Vincent, Good Hope, Adelaide, and Melbourne. Adelaide is 1,816 * miles nearer New York, and 3,587 miles nearer New Orleans hy Brito and Tahiti than by Good Hope. Wellington will be brought 5,617 † miles nearer New York by a Nicaragua Canal.

In Table VI the distances from Liverpool to Australasia and the Orient by way of the Nicaragua and Suez routes are contrasted.

With the exception of Wellington, the Pacific ports named in Table VI are nearer Liverpool via the Suez Canal than by way of Nicaragua. From Liverpool to Sydney, however, the distance via Brito and Tahiti is only 172 miles more than via Suez, Colombo, Adelaide, and Melbourne. Yokohama is but 547 miles farther from Liverpool via Brito and San Francisco than via the easterly route.

The route from Liverpool to Japan and China by way of the American isthmus passes close to both the Atlantic and Pacific seaboards of the United States. A vessel would add but 323 miles to the length of the voyage from Liverpool to Greytown by calling at New York city, the port ordinarily having the largest foreign commerce of any city in the world, and an export traffic going in all directions. By calling at the South Atlantic or Gulf ports of the United States, the raw and manufactured cotton which is exported in large quantities from the United States across the Pacific could be added to the vessel's cargo. A call at San Francisco or some other west coast port of the United States would enable the vessel to participate in the grain and lumber trade from the United States to Oriental countries. If the vessel making the trip from Liverpool to Asia is sailed under the American flag, it can participate in the coasting trade between the two seaboards of the United States.

The line connecting the places equidistant from Liverpool by way of the Nicaragua and Suez routes passes between New Zealand and Australia, runs east of the main island of Japan, and touches the continent of Asia on the Manchurian coast, some distance north of Vladivostok. As far as distance alone is determinative, the commerce of Liverpool with Australia and the Far East is tributary to the Suez route; but the commercial factors other than distance will, in all probability, so affect the routes of trade as to

* Omitting stop at Tahiti would add 52 miles to this figure; and if Melbourne were reached by Wellington rather than by Sydney it should be increased by 232 miles.

† Omitting stop at Tahiti would add 185 miles to this figure.

cause some of the outbound and inbound trade of Liverpool with the East to make use of the westerly route.

For the purpose of showing the relative advantages, as far as distance is concerned, which New York and Liverpool will possess for the Eastern trade after the isthmian canal has been completed, Table VII has been prepared.

New York will be nearer than Liverpool to New Zealand and the commercially important half of Australia. Liverpool, by way of the Suez route, will be nearer than New York by way of the Nicaragua route to the Philippines, Hong Kong, and Southern Asia. Shanghai will be almost the same distance from New York as from Liverpool. The advantage in favour of New York by way of Brito, San Francisco, the Great Circle, and Yokohama being 83 miles, the route from Liverpool by way of the Suez, including a call at Colombo, Singapore, and Hong Kong, Northern China, Manchuria, and Japan, will be considerably nearer New York than to Liverpool.

The line connecting the points equally distant from Liverpool and New York by the Suez and Nicaragua routes respectively, runs through the central part of Australia, through the western part of New Guinea, east of the Philippine Islands, and touches the mainland of Asia a little north of Shanghai.

Tables I–VII show the effect which a Nicaragua Canal would have upon the ocean distances from our eastern seaboard to the Pacific countries of America, Australia, and Asia. These tables also show the manner in which the comparative distances from our eastern seaboard and from Europe would be modified by a Nicaragua Canal. In Table VIII the Nicaragua and Panama Canal routes are contrasted, and the distances from typical Atlantic and Gulf ports of the United States and from representative European cities to the western coast of the American continents and to trans-Pacific countries by way of each canal route are given.

Table VIII shows very clearly that the Panama route is the more advantageous for the West South American trade, both with Europe and the United States. For the commerce of Europe and the United States with every other Pacific country, with the exception of New Zealand, to which the distances are practically equal, the Nicaragua is shorter than the Panama route. If the call be made at Tahiti on the voyage between Wellington and the American isthmus, the Nicaragua route is somewhat shorter than the one across Panama for the trade of North Atlantic countries with

New Zealand. If this voyage be made without the call at Tahiti, distance by way of the two canal routes is practically the same.

For convenience of comparison the following brief table is serviceable. The distances from New York, New Orleans, and Liverpool by way of the Nicaragua and Panama canal routes to San Francisco, Yokohama, Hong Kong, Sydney, Wellington, and Iquique are shown:

DISTANCES FROM NEW YORK, NEW ORLEANS AND LIVERPOOL VIA NICARAGUA AND PANAMA TO PACIFIC PORTS.

	New York.		New Orleans.		Liverpool.	
	NICARAGUA.	PANAMA.	NICARAGUA.	PANAMA.	NICARAGUA.	PANAMA.
San Francisco.......	4,921	5,299	4,118	4,698	7,651	8,038
Yokohama	9,457	9,835	8,654	9,234	12,187	12,574
Hong Kong.........	11,366	11,744	10,563	11,143	14,096	14,483
Sydney via Tahiti....	9,676	9,852	8,873	9,251	12,406	12,591
Wellington via Tahiti.	8,716	8,892	7,913	8,291	11,446	11,631
Iquique............	4,393	4,021	3,590	3,420	7,123	6,670

I.—DISTANCES VIA THE NICARAGUA AND MAGELLAN ROUTES BETWEEN THE EASTERN PORTS OF THE UNITED STATES AND THE PORTS OF THE WEST COAST OF NORTH, CENTRAL AND SOUTH AMERICA.

FROM	VIA	TO SITKA.	TO PORT TOWNSEND.	TO PORTLAND.	TO SAN FRANCISCO.	TO SAN DIEGO.	TO ACAPULCO.	TO SAN JOSÉ DE GUATEMALA.	TO HONOLULU.	TO GUAYAQUIL.	TO CALLAO.	TO IQUIQUE.	TO VALPARAISO.	TO CORONEL.
Portland, Me.	Nicaragua.....	6,418	5,891	5,766	5,116	4,668	3,291	2,736	6,626	3,441	3,946	4,588	5,173	5,356
	Magellan*.....	15,021	14,494	14,369	13,719	13,342	11,896	11,466	14,854	10,428	9,707	9,226	8,466	8,235
Boston......	Nicaragua.....	6,373	5,856	5,731	5,081	4,933	3,256	2,761	6,591	3,403	3,911	4,553	5,138	5,321
	Magellan*.....	14,986	14,459	14,334	13,684	13,307	11,861	11,431	14,819	10,393	9,672	9,199	8,431	8,200
New York...	Nicaragua.....	6,223	5,696	5,571	4,921	4,473	3,096	2,541	6,431	3,246	3,751	4,393	4,978	5,161
	Magellan......	15,016	14,489	14,364	13,714	13,337	11,891	11,461	14,849	10,423	9,702	9,221	8,461	8,230
Philadelphia .	Nicaragua....	6,171	5,636	5,511	4,861	4,413	3,036	2,481	6,371	3,186	3,691	4,333	4,918	5,101
	Magellan*.....	15,066	14,539	14,414	13,764	13,387	11,941	11,511	14,899	10,473	9,752	9,271	8,511	8,280
Baltimore ...	Nicaragua.....	6,143	5,616	5,491	4,841	4,393	3,016	2,461	6,351	3,166	3,671	4,313	4,898	4,581
	Magellan*.....	15,078	14,551	14,426	13,776	13,399	11,953	11,523	14,911	10,485	9,764	9,283	8,523	8,292
Norfolk.....	Nicaragua.....	6,013	5,486	5,361	4,711	4,263	2,886	2,331	6,221	3,036	3,541	4,191	4,768	4,951
	Magellan*.....	14,942	14,415	14,290	13,640	13,263	11,817	11,387	14,775	10,349	9,628	9,147	8,387	8,156
Charleston...	Nicaragua†	5,727	5,200	5,075	4,425	3,977	2,600	2,045	5,935	2,750	3,255	3,897	4,482	4,665
	Magellan*....	14,951	14,424	14,299	13,649	13,272	11,826	11,396	14,784	10,358	9,637	9,156	8,396	8,165
Savannah ...	Nicaragua‡....	5,733	5,206	5,081	4,421	3,983	2,606	2,051	5,941	2,756	3,261	3,903	4,488	4,671
	Magellan*.....	14,980	14,453	14,328	13,678	13,301	11,855	11,425	14,813	10,387	9,666	9,185	8,425	8,194
Jacksonville .	Nicaragua§....	5,683	5,156	5,031	4,381	3,933	2,556	2,001	5,891	2,706	3,211	3,853	4,438	4,621
	Magellan*.....	14,955	14,428	14,303	13,653	13,276	11,830	11,400	14,788	10,362	9,641	9,160	8,400	8,169
Port Tampa .	Nicaragua.....	5,280	4,753	4,628	3,978	3,530	2,153	1,598	5,488	2,303	2,808	3,450	4,035	4,218
	Magellan*.....	15,116	14,589	14,464	13,814	13,437	11,991	11,561	14,949	10,523	9,802	9,321	8,561	8,339
Penascola....	Nicaragua....	5,386	4,859	4,734	4,084	3,636	2,259	1,704	5,594	2,409	2,914	3,556	4,144	4,324
	Magellan*.....	15,320	14,793	14,668	14,018	13,641	12,195	11,765	15,153	10,727	10,006	9,525	8,765	8,534
Mobile	Nicaragua.....	5,314	4,886	4,761	4,111	3,663	2,286	1,731	5,621	2,436	2,941	3,583	4,168	4,351
	Magellan*.....	15,362	14,835	14,710	14,060	13,683	12,237	11,807	15,195	10.769	10,048	9,567	8,807	8,576
New Orleans.	Nicaragua.....	5,420	4,893	4,768	4,118	3,670	2,293	1,738	5,628	2,443	2,948	3,590	4,175	3,558
	Magellan*.....	15,416	14,889	14,764	14,114	13,737	12,291	11,861	15,249	10,823	10,102	9,621	8,861	8,630
Galveston ...	Nicaragua.....	5,603	5,076	4,951	4,301	3,853	2,476	1,921	5,811	2,626	3,131	3,773	4,358	4,541
	Magellan*.....	15,598	15,071	14,946	14,296	13,919	12,473	11,043	15,431	11,005	10,284	9,803	9,043	8,812

* Via Pernambuco, Callao and San Francisco for points beyond these ports.
† Vessels going by west end of Cuba will shorten voyage 69 miles for Charleston.
‡ 104 for Savannah.
§ 136 for Jacksonville.

II.—DISTANCES FROM EUROPE TO PACIFIC PORTS VIA THE NICARAGUA CANAL AND THE STRAITS OF MAGELLAN.

TO	From Liverpool via		From Hamburg via		From Antwerp via		From Bordeaux via		From Gibraltar via	
	NICARAGUA.	MAGELLAN*.	NICARAGUA.	MAGELLAN*.	NICARAGUA.	MAGELLAN*.	NICARAGUA.	MAGELLAN*.	NICARAGUA.	MAGELLAN*.
Sitka	8,939	15,386	9,470	15,836	9,191	15,557	8,941	15,073	8,675	14,455
Port Townsend	8,426	14,859	8,943	15,309	8,664	15,030	8,414	14,546	8,148	13,928
Portland	8,287	14,734	8,818	15,184	8,359	14,905	8,289	14,421	8,026	13,803
San Francisco	7,651	14,084	8,168	14,534	7,889	14,255	7,639	13,771	7,373	13,153
San Diego	7,201	13,707	7,718	14,157	7,439	13,878	7,189	13,394	6,923	12,776
Acapulco	5,826	12,261	6,343	12,771	6,064	12,432	5,814	11,948	5,548	11,330
San José de Guatemala	5,271	11,831	5,788	12,281	5,509	12,002	5,259	11,518	4,993	10,900
Honolulu	9,161	15,219	9,678	15,669	9,399	15,390	9,149	14,906	8,883	14,288
Guayaquil	5,975	10.722	6,493	11,172	6,214	10,893	5,964	10,409	9,698	9,791
Callao	6,481	10,072	6,998	10,522	6,719	10,243	6,469	9,259	6,203	9,141
Iquique	7,123	9,591	7,640	10,041	7,361	9,762	7,111	9,278	6,845	8,660
Valparaiso	7,708	8,831	8,222	9,281	7,946	9,002	7,696	8,518	7,430	7,900
Coronel	7,891	8,600	8,408	9,050	8,129	8,771	7,879	8,287	7,613	7,669

* Via Pernambuco, Callao, and San Francisco for ports north of those cities.

III.—DISTANCES FROM ATLANTIC AMERICAN PORTS TO YOKOHAMA, SHANGHAI AND HONG KONG VIA THE NICARAGUA AND SUEZ ROUTES.

FROM	To Yokohama via			To Shanghai via			To Hong Kong via			
	San Francisco and Great Circle.	Honolulu.	Suez*, Colombo, Singapore, Hong Kong and Shanghai.	San Francisco, Great Circle and Yokohama.	Honolulu and Yokohama.	Suez†, Colombo, Singapore and Hong Kong.	San Francisco Great Circle, Yokohama and Shanghai.	Honolulu, Yokohama, Shanghai.	Honolulu, Guam and Manila.	Suez, Colombo, Singapore.
Portland	9,652	10,026	13,330	10,702	11,076	12,280	11,561	11,935	12,097	11,421
Boston	9,617	9,991	13,370	10,667	11,041	12,320	11,526	11,900	12,062	11,461
New York	9,457	9,831	13,564	10,507	10,881	12,514	11,366	11,740	11,902	11,655
Philadelphia	9,397	9,771	13,707	10,447	10,821	12,657	11,306	11,680	11,842	11,798
Baltimore	9,377	9,751	13,852	10,427	10,801	12,802	11,286	11,660	11,822	11,943
Norfolk	9,247	9,621	13,727	10,297	10,671	12,677	11,156	11,530	11,692	11,818
Charleston	9,037‡	9,411‡	13,982	10,087‡	10,461‡	12,932	10,946‡	11,320‡	11,482‡	12,073
Savannah	9,043§	9,417§	14,057	10,093§	10,467§	13,007	10,952§	11,326§	11,488§	12,148
Jacksonville	9,001‖	9,375‖	14,137	10,051‖	10,425‖	13,087	10,910‖	11,248‖	11,446‖	12,228
Port Tampa	8,514	8,888	14,629	9,564	9,938	13,579	10,423	10,797	10,959	12,720
Pensacola	8,620	8,994	14,833	9,670	10,044	13,783	10,529	10,903	11,065	12,924
Mobile	8,647	9,021	14,875	9,697	10,071	13,825	10,556	10,930	11,092	12,966
New Orleans	8,654	9,028	14,929	9,704	10,078	13,879	10,563	10,937	11,099	13,020
Galveston	8,757	9,131	15,111	9,807	10,181	14,061	10,666	11,040	11,202	13,202

* Direct voyage from Singapore to Yokohama reduces this distance by 393 miles.
† Direct voyage from Singapore to Shanghai reduces this distance by 66 miles.
‡ Vessels going by west end of Cuba will shorten voyage 69 miles for Charleston.
§ 104 miles for Savannah.
‖ 136 miles for Jacksonville.

IV.—DISTANCES FROM AMERICAN ATLANTIC PORTS TO MANILA VIA NICARAGUA AND SUEZ ROUTES.

FROM	VIA SAN FRANCISCO, GREAT CIRCLE AND YOKOHAMA	VIA HONOLULU AND YOKOHAMA.	VIA HONOLULU, YOKOHAMA, SHANGHAI AND HONG KONG.	VIA HONOLULU AND GUAM.	VIA SUEZ, COLOMBO, SINGAPORE.
Portland	11,402	11,776	12,563	11,469	11,367
Boston	11,367	11,741	12,528	11,434	11,407
New York	11,207	11,581	12,368	11,274	11,601
Philadelphia	11,147	11,521	12,308	11,214	11,744
Baltimore	11,127	11,501	12,288	11,194	11,889
Norfolk	10,997	11,371	12,158	11,064	11,764
Charleston*	10,711	11,085	11,872	10,778	12,019
Savannah†	10,717	11,091	11,878	10,784	12,094
Jacksonville‡	10,667	11,041	11,828	10,734	12,174
Port Tampa	10,264	10,638	11,425	10,331	12,266
Pensacola	10,370	10,744	11,531	10,437	12,870
Mobile	10,397	10,771	11,558	10,464	12,912
New Orleans	10,404	10,778	11,565	10,471	12,966
Galveston	10,587	10,961	11,748	10,654	13,148

* The route to Greytown via west end of Cuba is 69 miles less.
† The route to Greytown via west end of Cuba is 104 miles less.
‡ The route to Greytown via west end of Cuba is 136 miles less.

V.—DISTANCES BETWEEN THE EASTERN SEABOARD OF THE UNITED STATES AND AUSTRALIA VIA THE NICARAGUA AND SUEZ ROUTES.

FROM	To Adelaide via		To Melbourne via		To Sydney via		To Wellington via		
	Brito, Tahiti, Sydney, Melbourne.	St. Vincent, Cape of Good Hope.	Brito, Tahiti and Sydney.	St. Vincent, Cape of Good Hope, Adelaide.	Brito and Tahiti.*	St. Vincent, Good Hope, Adelaide and Melbourne.	Brito and Tahiti*.	St. Vincent, Cape of Good Hope and Melbourne.	Straits of Magellan.
Portland........	10,954	12,446	10,446	12,954	9,871	13,529	8,911	14,204	11,419
Boston..........	10,919	12,459	10,411	12,967	9,836	13,542	8,876	14,217	11,384
New York.......	10,759	12,575	10,251	13,083	9,676	13,658	8,716	14,333	11,414
Philadelphia.....	11,699	12,641	10,191	13,149	9,616	13,724	8,656	14,399	11,464
Baltimore.......	10,679	12,736	10,171	13,244	9,596	13,819	8,632	14,494	11,476
Norfolk.........	10,549	12,614	10,041	13,122	9,466	13,697	8,510	14,372	11,140
Charleston......	10,265	12,761	9,155	13,269	9,180	13,844	8,220	14,519	11,349
Savannah.......	10,269	12,821	9,671	13,329	9,186	13,904	8,226	14,579	11,378
Jacksonville.....	10,219	12,846	9,711	13,354	9,136	13,929	8,196	14,604	11,353
Port Tampa.....	9,816	12,243	9,308	13,751	8,733	14,326	7,773	15,001	11,514
Pensacola.......	9,922	13 447	9,414	13,955	8,839	14,530	7,879	15,205	11,718
Mobile..........	9,949	13,489	9,441	13,997	8,866	14,572	7,906	15,247	11,760
New Orleans....	9,956	13,543	9,448	14,051	8,873	14,626	7,913	15,301	11,814
Galveston.......	10,139	13,725	9,631	14,233	9,056	14,808	8,096	15,483	11,996

* The course from Brito to Sydney direct, omitting call at Tahiti, would be 52 miles less.

VI.—DISTANCES FROM LIVERPOOL TO THE EAST BY THE SUEZ AND NICARAGUA ROUTES.

TO	Suez Route		Nicaragua Route.		DIFFERENCE SUEZ–NICARAGUA†
	PORTS OF CALL.	MILES.	PORTS OF CALL.	MILES.	
Adelaide	Aden,* Colombo, Kg. George Sound	11,151	Brito, Tahiti, Sydney, Melbourne‖	13,489	–2,338
Melbourne	Aden,* Colombo, Kg. George Sd., Adel.	11.659	Brito, Tahiti, Sydney‖	12,981	–1,322
Sydney	Aden,* Colombo, Kg. G. Sd., Adel., Mel.	12,234	Brito, Tahiti ‖	12,406	– 172
Wellington	Aden,* Colombo, K. G. S., Melbourne	12,949	Brito, Tahiti§	11,446	†1,503
Manila	Aden,* Colombo, Singapore	9,677	Brito, San Francisco, Yokohama‡	13,937	–4,260
Hongkong	Aden,* Colombo, Singapore	9,731	Brito, San Francisco, Yokohama†	13,777	–4,046
Tientsin	Aden, Colombo, Sing., Hongk., Shanghai	11,362	Brito, San Francisco, Yokohama	13,554	–2,192
Yokohama	Aden, Colombo, Sing., Hongk., Shanghai	11,640	Brito, San Francisco	12,187	– 547

* Direct voyage from Aden to King George Sound would shorten these routes 540 miles.

† A stop at Shanghai would add to this route 319 miles.

‡ A stop at Shanghai would add to this route 535 miles.

§ Direct voyage from Brito to Wellington would shorten this distance by 185 miles and make the difference 1,688 miles.

‖ Direct voyage from Brito to Sydney would shorten these routes 52 miles.

VII.—COMPARISONS OF DISTANCES FROM NEW YORK AND LIVERPOOL TO AUSTRALASIAN AND ASIATIC PORTS VIA THE NICARAGUA AND SUEZ ROUTES.

TO	From New York		From Liverpool.		Difference Suez–Nicaragua†
	Route.	Miles.	Route.	Miles.	
Wellington	Brito, Tahiti	8,716	Aden‡, Colombo, Kg. George Sd. Melbourne	12,949	+4,233
Sidney	Brito, Tahiti*	9,676	Aden‡, Colombo, Kg. George Sd., Adel., Melbourne	12,234	+2,558
Adelaide	Brito, Tahiti*, Sydney†, Melbourne	10,759	Aden‡, Colombo, Kg. George Sd	11,151	+ 392
Manila	Brito, San Francisco, Gt. Circle, Yokohama	11,207	Aden, Colombo, Singapore	9,677	−1,530
Hongkong	Brito, San Francisco, Gt. Circle, Yokohama	11,047	Aden, Colombo, Singapore	9,731	−1,316
Shanghai	Brito, San Francisco, Gt. Circle, Yokohoma	10,507	Aden, Colombo, Singapore, Hongkong	10,590	+ 83
Tientsien	Brito, San Francisco, Gt. Circle, Yokohama	10,824	Aden, Colombo, Singapore, Hongkong, Shanghai	11,362	+ 538
Yokohama	Brito, San Francisco, Gt. Circle	9,457	Aden, Colombo, Singapore, Hongkong, Shanghai	11,640	+2,183

* Omitting stop at Tahiti will shorten voyage 52 miles.

† If vessel goes by Wellington and Melbourne, voyage will be shortened 232 miles.

‡ Omitting stop at Colombo will shorten voyage 540 miles.

VIII.—COMPARISON OF DISTANCES FROM AMERICAN AND EUROPEAN ATLANTIC PORTS TO PACIFIC PORTS VIA THE NICARAGUA AND PANAMA CANALS.

FROM	VIA	TO PORT TOWNSEND VIA SAN FRANCISCO.	TO SAN FRANCISCO.	TO GUAYAQUIL.	TO CALLAO.	TO IQUIQUE.	TO VALPARAISO.	TO CORONEL.	TO YOKOHAMA VIA SAN FRANCISCO.	TO SHANGHAI *VIA SAN FRANCISCO AND YOKOHAMA.	TO MANILA *VIA SAN FRANCISCO AND YOKOHAMA.	TO SYDNEY †VIA TAHITI.	TO MELBOURNE ‡VIA TAHITI§ AND SYDNEY.	TO WELLINGTON VIA TAHITI§.
New York...	Nicaragua....	5,696	4,921	3,246	3,751	4,393	4,928	5,161	9,457	10,507	11,207	9,676	10,251	8,716
	Panama......	6,074	5,299	2,864	3,359	4,021	4,630	4,838	9,835	10,885	11,585	9,852	10,427	8,892
Norfolk.....	Nicaragua....	5,485	4,710	3,035	3,540	4,182	4,767	4,950	9,247	10,297	10,997	9,466	10,041	8,505
	Panama......	5,872	5,097	2,662	3,157	3,819	4,428	4,636	9,634	10,684	11,384	9,650	9,858	8,690
Charleston...	Nicaragua....	5,276	4,501	2,826	3,331	3,973	4,558	4,741	9,037	9,957	10,505	9,250	9,831	8,296
	Panama......	5,673	4,898	2,463	2,958	3,638	4,229	4,437	9,344	10,367	10,809	9,451	10,006	8,491
Port Tampa.	Nicaragua....	4,753	3,978	2,303	2,808	3,450	4,035	4,218	8,514	9,564	10,264	8,733	9,308	7,773
	Panama......	5,328	4,553	2,098	2,593	3,255	3,864	4,072	9,069	10,119	10,819	9,086	9,661	8,126
New Orleans.	Nicaragua....	4,893	4,118	2,443	2,948	3,590	4,175	4,358	8,654	9,704	10,404	8,873	9,448	7,913
	Panama......	5,477	4,698	2,263	2,758	3,420	4,029	4,237	9,234	10,284	10,984	9,251	9,826	8,291
Galveston...	Nicaragua....	4,996	4,221	2,546	3,051	3,693	4,278	4,461	8,757	9,887	10,587	9,056	9,551	8,016
	Panama......	5,574	4,799	2,364	2,858	3,520	4,129	4,338	9,335	10,385	11,085	9,352	9,927	8,392
Liverpool...	Nicaragua....	8,426	7,651	5,975	6,481	7,123	7,708	7,891	12,187	13,237	13,937	12,406	12,891	11,446
	Panama......	8,813	8,038	5,603	6,098	6,760	7,369	7,577	12,574	13,624	14,324	12,591	13,166	11,631
Hamburg...	Nicaragua....	8,943	8,168	6,493	6,998	7,640	8,225	8,408	12,704	13,754	14,454	12,923	13,498	11,963
	Panama......	9,242	8,467	6,032	6,527	7,189	7,798	8,006	13,003	14,053	14,753	13,020	13,595	12,060
Antwerp....	Nicaragua....	8,664	7,889	6,214	6,719	7,361	7,946	8,129	12,425	13,475	14,175	12,644	13,219	11,684
	Panama......	8,963	8,188	5,753	6,248	6,910	7,519	7,727	12,724	13,774	14,474	12,741	13,316	11,781
Bordeaux....	Nicaragua....	8,414	7,639	5,964	6,469	7,111	7,696	7,879	12,175	13,225	13,925	12,394	12,969	11,434
	Panama......	8,713	7,938	5,503	5,998	6,660	7,269	7,477	12,474	13,524	14,224	12,491	13,066	11,471
Gibraltar....	Nicaragua....	8,148	7,373	5,698	6,203	6,845	7,430	7,613	11,909	12,959	13,659	12,128	12,703	12,800
	Panama......	8,447	7,672	5,237	5,723	6,394	7,003	7,211	12,208	13,258	13,958	12,225	11,168	11,265

* Via Honolulu and 374 miles for Nicaragua and 252 for Panama. † Omitting Tahiti reduces voyage from Brito by 52 miles.
‡ Voyage from Brito to Sydney by Wellington is 232 miles less than by way of Tahiti; from Panama it is 405 miles less.
§ Voyage from Brito to Wellington direct is 185 miles shorter than via Tahiti, and from Panama it is 358 miles shorter.

CORNELL SUMMER SCHOOL OF GEOLOGY AND GEOGRAPHY.

The Summer School of Geology and Geography, in connection with the regular summer session of Cornell University, offers courses for students in various stages of advance in geographic science; courses for teachers in the grades, for high school and normal school teachers, and for college students and teachers. The school has been organized, and the courses arranged, in response to what seems to be a demand for instruction in geographic and geologic fact, correlated with courses in method and procedure in the teaching of the earth sciences. A broad range of geographic subject-matter is offered in the various courses. There are a number of courses on the pedagogical side, in which methods are presented rather than subject-matter; and ample provision is made for instruction in the laboratory and field aspects of the subject.

In the selection of the staff care has been taken to secure men whose previous work qualifies them to treat special phases of the subject, and whose fitness to do so will be generally recognized by teachers. The director and organizer of the school is Professor R. S. Tarr, of Cornell University, who also offers lecture courses in Physical Geography and the Geography of Europe. Geology and the Geography of the United States are offered by Professor A. P. Brigham, of Colgate University, who, like Professor Tarr, is well known as an author of successful school books. Both of these men will actively participate in the field work, in the direction of advanced study, and in the conferences, of which a feature is made. Dr. Charles McMurry, one of the best-known teachers of geography in the middle West, and the writer of several books on pedagogical subjects, relating especially to the pedagogy of geography, offers courses in Home Geography and in Grammar School Geography; Supervisor Whitbeck, of the State Normal and Model Schools at Trenton, N. J., who has achieved marked success in geographic work in his own State, and a former teacher in the Summer School of the South, offers courses on Class Room Problems and Laboratory Methods in the grades; Principal Emerson, of the Cobbet School, Lynn, Mass., one of the most active geography teachers in New England, offers lecture and laboratory work in Commercial Geography; Assistant Principal Carney, of the Ithaca High School, conducts the Laboratory Work in Physical Geography; and the other instructors are actively identified with the teaching of geography.

The allied courses in the Summer Session—botany, zoology, education, history, economics, etc.—and the college atmosphere, together with the library, museum, and laboratory facilities, add to the advantages of the school.

Cornell University is beautifully situated on a hillside 400 feet above Cayuga, the most beautiful of the Finger Lakes. A better place could scarcely be found for varied field work than in this dissected plateau region of central New York, to which glaciation has added many problems of scientific interest, and formed the many gorges and waterfalls for which the region is famed. The campus is bordered by two deep gorges, one of which, Fall Creek gorge, contains five considerable waterfalls, including Ithaca Falls, 156 feet high; while within walking distance of the University are 15 good-sized cataracts, 6 of which are over 100 feet high, and one, Taughannock Falls (220 feet), is the highest fall in the State. In the field work excursions are made on foot, and by wagon, steamer, and train, to most of these points, as well as to Niagara, to the coal mines at Wilkes Barre, to Watkins Glen, to Union Springs, and to the shore of Lake Ontario. No more delightful place for a summer vacation could be chosen; and, by the proper combination of indoor and outdoor work, the teacher may escape the danger of overwork, which is the chief objection to spending the vacation at a Summer School, and yet gain an inspiration and add to the store of knowledge which every genuine teacher needs constantly to increase.

Cornell passed through a severe typhoid epidemic last winter, which, for a time, threatened to cause the abandonment of the Summer Session. This epidemic is not only past, but the town is probably safer now than ever before, for it has been for months under the care of one of the most eminent sanitary engineers of the country, and no known precaution has been omitted to guard against a possible recurrence of the epidemic. Probably few cities would undertake such thorough methods to avoid a repetition of the disease, for Ithaca is almost entirely dependent on the University, and another outbreak would be most disastrous to the University, and, therefore, to the city. It is on the assurance of Dr. Soper, the sanitary engineer in charge of the city, that Ithaca is a safe place to come to, that the plans of the Summer Session are to be carried out.

It seems unfortunate that this first attempt by an American university to offer a wide range of geographic instruction for teachers should have had its success endangered by the unforeseen outbreak of an epidemic. With the range of courses, the able staff of instructors, the connection with a large university, and in a region rich in

geographic and geologic phenomena, as well as beautiful and attractive scenically, the experiment ought to succeed, and probably will. If it does it will be an event of importance in American geography, for it will open up to teachers an opportunity to learn under good guidance how to better their work, and that will have the tendency to place geography teaching on a higher plane. Moreover, it will encourage other universities to develop similar schools. One of the great needs of geography to-day is to have the great army of teachers better trained; and such a school as this offers an opportunity for such training.

ABSTRACT OF A LECTURE BY MR. HARRY DE WINDT,

MARCH 7, 1903.

"PARIS TO NEW YORK OVERLAND."

Mr. de Windt, the Vicomte de Clinchamp, and Mr. George Harding left Paris in December, 1900, to reach New York by way of Siberia and Alaska. At Irkutsk, where they arrived in ten days, they took sleighs and followed the frozen Lena to Yakutsk, a journey of nearly 2,000 miles in a northeasterly direction. The temperature was from 15 to 35 degrees below zero. Horses were changed at the post-houses, thirty miles apart. It took twenty-three days to reach Yakutsk, where the horses were changed for reindeer.

The next stage was to Verkhoyansk, 600 miles to the north, and the coldest inhabited place on the globe, with an average temperature for the year of 2 degrees Fahrenheit. On this stage the post-houses were sometimes 80, sometimes 150 miles apart. They left Verkhoyansk on the 2d of March for Srednekolymsk, 1,100 miles to the northeastward. This distance was made in twenty-three days, through blinding snowstorms. At Srednekolymsk dog-sleds were procured and the travellers set out for Bering Strait. They were often without the means of making a fire, the dogs gave out and went mad, and when Chaun Bay was reached the provisions were exhausted. The next day a Chukchi settlement was found. East Cape was reached on the 19th of May. Here the party were taken on board the U. S. Revenue cutter *Thetis*, and landed on the opposite coast. Then they went by a trading steamer to Cape Nome, and thence to New York.

Mr. de Windt thinks that almost any engineering feat is possible, but he regards the building of a railroad over the vast Siberian tundras and the tunnelling of Bering Strait as enterprises little likely to attract the attention of capitalists for a long time to come.

GEOGRAPHICAL RECORD.

AMERICA.

The Mapping of the United States.—In co-operation with the Commissioner of Agriculture of North Carolina the topographic branch of the United States Geological Survey has made considerable progress during the past two years in mapping the eastern coastal plain of North Carolina. During the past season the survey of eight atlas sheets was completed—namely, Edenton, on Albemarle Sound, and Vanceboro, Ayden, Tarboro, Rocky Mount, Wilson, Spring Hope, and Kenly, at the head of Pamlico River and west thereof.

This is a most interesting region topographically because of the exceeding flatness of the slopes and the great fresh-water marshes with which the region is covered, from which rise the brushy bog lands known in this region as *pocosons*. The object of this survey has been to furnish a basis upon which the State Agricultural Commissioner, in co-operation with the Bureau of Soils of the United States Department of Agriculture, may make a careful map and study of the soils, with a view to the further development of truck farming and tobacco-growing, which have become such important industries in this region. The rivers, as the Tar, in the neighbourhood of Tarboro, flow in wide meanders through broad valleys, and are bordered alternately on one bank or the other by steep-cut banks twenty to thirty feet in height.

Above these low flood bottoms, which are at all times swampy and are often overflowed, the upland has gentle slopes, often not exceeding five feet to the mile. Upon the higher portions of these uplands occur the pocosons, their characteristics being unusual and of a kind best known and best shown on the northern edge of this region in the Dismal Swamp. In the Vanceboro area Big Pocoson, probably one of the largest in the region, covering an area of about 75 square miles, has an altitude a trifle over 40 feet near its centre, the country sloping thence to the outer margins, where the elevation averages twenty feet. The whole of this and the neighbouring pocosons is densely covered with a heavy growth of impenetrable wood and brush. So closely does this grow that it was impossible for the surveyors to enter without incurring great expense for cutting and for building corduroy roads over the swampy land. In spite of the forbidding nature of these pocosons,

however, they are rapidly being reclaimed. Railroads and county highways and lumber roads have in recent years been opened into and through some of them, and, by the aid of drainage, farming has encroached upon them until some have nearly disappeared through conversion to agricultural uses. H. M. W.

Good progress was made in 1902 in the co-operative mapping of the State of Pennsylvania by the United States Geological Survey. During that season there were mapped four atlas sheets in the central-western portion of the State, where important coal interests are developing—in Clearfield, Indiana, and neighbouring counties; also a couple of sheets in the western portion of the State and one in the eastern. The latter, the Lancaster sheet, represents some interesting topographic features, and includes an area of well-cultivated farm lands, and a portion of the Susquehanna River, in which important water-power developments are now in progress. Thousands of dollars have been recently expended in surveys for canals to divert the waters of the Susquehanna. At least two great corporations are now engaged in construction, which must make Lancaster, Columbia, and York important industrial centres in the near future.

The development of new coal lands in Indiana and Clearfield counties is a matter of recent years, and of great importance. The area shown on the maps is on the crest of the Alleghenies, where the general surface elevations average nearly 2,000 feet. The summit of the Alleghenies in this region is a high tableland, slightly eroded, the stream bottoms being at altitudes of about 1,000 feet. The crests of the tableland average 1,500 to 2,000 feet. The whole surface of the country is densely covered with timber, so that, as viewed from above, it has much the aspect of a plain, the undulating mountain surfaces and stream valleys not being visible until more nearly approached.

One of the most effective sheets mapped by this Bureau in Pennsylvania is the Newcastle sheet, which is on the border of Ohio, immediately northwest of Pittsburg. Through the centre of it, flowing north and south, is Beaver River, in a valley averaging a mile in width, bordered by steep-cut banks about 100 feet in height, above which is a broad flood-plain at an average elevation of 900 feet, and of very level and uniform slope. In this flood-plain are built the great industrial seats of Beaver Falls, Elmwood City, and Newcastle. The southwestern portion is much like that surrounding Pittsburg—a rolling, hilly country of from 1,000 to

1,200 feet in altitude. The northwestern flattens out abruptly towards the more level region bordering Lake Erie. It has very gentle slopes and changes of elevation, varying only between 1,100 to 1,200 feet. H. M. W.

During 1902 the United States Geological Survey completed the mapping, in co-operation with the State of New York, of two of the most important resort areas in the Adirondacks. These include an area of about 500 square miles, represented on the Saranac Lake and Long Lake sheets. In the progress of this survey there had previously been completed in the Adirondacks 20 atlas sheets, covering about 5,000 square miles, and there remain unmapped not much over 1,000 square miles in the northwestern portion of the region.

The sheets above named represent some of the most interesting features of the lake region. The Saranac Lake sheet includes the Rainbow Lake and Osgood and Jones Ponds, within the Rockefeller Preserve; also Clear Lake, McCaulley, Colby, and McKenzie Ponds; also the whole of lower Saranac Lake, a portion of middle Saranac Lake, Lonesome Pond, and the flow above it known as Miller Pond. Near the centre of the sheet is Saranac Lake village. There are some agreeable contrasts in topography to be observed on this sheet. Near the southwestern corner are the high mountains bordering on Mts. Marcy, Morris, and White Face. Mt. McKenzie, the highest peak on the sheet, has an altitude of 3,872 feet. In the northwestern portion of the sheet are great level plains, true swamps, and covered mostly with blue berries, one of the best-known blueberry plains in the State of New York, extending from a few miles above Saranac to Bloomingdale Station, through which the Chateaugay railroad passes with a tangent about four miles in length. The lower Saranac River from the village to Bloomingdale wanders through another swampy blueberry plain. To the west the New York Central railroad runs through a sloping plain of considerable extent, reaching from Paul Smith's Station to Saranac Junction. Interesting features in the area are Rainbow Lake, Clear Pond, and their borders, the marginal slopes of which consist of a series of sand hills and pot-holes of rather unique topographic aspect.

The Long Lake sheet depicts the larger portion of the Raquette Pond and part of Big Tupper Lake, all of Big Simon and Follensby Ponds, also Catlin Lake, and the entire northern half of Long Lake. These lakes and ponds are in a country much more moun-

tainous and broken than that about Saranac, and the ponds are at much higher elevation, with precipitous shores rising to the higher mountains. Among the more important of these is Mt. Morris, reaching 3,163 feet. The northern portion of this area is a great flooded plain, out of which numerous low hills rise and through which the Raquette River flows into Big Tupper Lake, near Tupper Lake village. This river was one of the old thoroughfares of travel from the northern to the southern portions of the Adirondacks by boat, and in the centre of the sheet are the celebrated Raquette Falls—a most picturesque group of cascades.

H. M. W.

Water Supply and Irrigation Papers.—In No. 76 of this series of reports published by the United States Geological Survey, Mr. H. A. Pressey says that the development of water power in this country has never made such strides as during the past ten years. The last census shows that the increase in the utilization of water power from 1890 to 1900 was about 30 per cent., or 472.361 horse power. In Maine the developed power increased 60 per cent. The paper, which is entitled "Observations on the Flow of Rivers in the Vicinity of New York City," is largely devoted to the methods of collecting data with regard to the flow of rivers, including the results of observations made on Catskill, Esopus, and Rondout creeks, and the Wallkill and Housatonic Rivers.

No. 68, by Mr. L. H. Taylor, is entitled, "Water Storage in the Truckee Basin, California-Nevada." It relates to surveys made by Mr. Taylor to learn how far the water of Truckee River may be used to develop the arid lands of Nevada. He shows that, by means of dams and other hydraulic works, a large amount of water which now runs to waste may be conducted upon vacant public land. Hydrographer Newell is of the opinion that the construction of these works would do much to increase the cultivated area and population of Nevada.

The Maryland Geological Survey.—This Survey has now issued three volumes dealing with the physical features of the several counties of Maryland. Vol. I (Allegany Co.) was published in 1900, and Vols. II (Cecil Co.) and III (Garrett Co.) were issued last year. Each volume embraced a description of the surface features, geology, mineral resources, soils, climate, hydrography, forests, and other characteristics of the region treated. The papers are written by members of the State Survey or other specialists, including a number from the Washington Departments.

There are many fine photographs, most of them taken by the authors of papers during their field work, and each volume is accompanied by large-scale topographical, geological, and soil maps. These are detailed geological and geographical studies of educational and economic value to the citizens and to all who may contemplate settling or investing in these counties. A considerable number of economic deposits not yet utilized are mentioned.

The Survey has also issued Vol. IV of the *General Reports.* The volume contains an account of the results reached concerning the various changes in Western Maryland during geologic time; the latest information concerning the highways of the State and the efforts to improve their condition; and an exhaustive discussion of the extensive clay deposits of Maryland.

The Central Ohio Natural Gas Fields.—Four reservoirs of natural gas have thus far been discovered in central Ohio. The Thurston and Newark fields were long ago exhausted, and the fields from which gas is now derived are known as the Sugar Grove and Homer. The most important is Sugar Grove, which occupies parts of Fairfield and Hocking counties. As developed in 1902, its length is 16 miles, and its maximum width 11 miles. The Homer Field, as developed in 1902, includes parts of Licking and Knox counties. Geographically and geologically they are closely related. The gas rock lies near the base of the Clinton sandstone formation, and is separated from the underlying Medina by a few feet of dark slate. The gas rock is a light-coloured sandstone of moderate grain, drills hard, and the thickness of the stratum is not definitely known, the maximum reported being 34 feet, and the average, perhaps, one-half of that. In 1902 at least 60,000,000 cubic feet of gas were taken, on an average, from the Sugar Grove field every twenty-four hours, supplying many towns in northern and northwestern Ohio, including Toledo, Columbus, Newark, Zanesville, and other towns in central Ohio; Dayton and other cities in western Ohio, and a number of other towns. This territory has passed its zenith, and, unless extensions are found, its production may rapidly decrease. The Homer field was opened in 1900, and has developed two great wells flowing about 9,000,000 and 11,000,000 cubic feet a day, besides a number of others, ranging from 4,000,000 to 6,000,000. As yet the pressure is high and the gas is supplementing the supply of fuel from Sugar Grove, and may do much more. (*The American Geologist*, April, 1903.)

Porto Rico.—The Second Annual Report of Governor Hunt, of Porto Rico, issued from the Government Printing Office, Washington, includes an excellent summary of the resources and industries of the island. Although nearly 1,000,000 persons live on this small island, whose area is about 2,347,520 acres, only about 20 per cent. of the land is cultivated, 51 per cent. being devoted to pastures, 7 per cent. waste land, and 22 per cent. is in roads, streams, towns, and forests. Of the cultivated lands, 61,556 acres are in sugar cane, 122,358 in coffee, 4,222 in tobacco, 93,508 in beans, rice, and corn, and 17,176 in fruits. Sixty-three per cent. of the population is engaged in agriculture. There are still about 100,000 acres of public lands, some of which are valuable for agriculture and timber, and others will be available for the extension of the larger cities. The prices of agricultural land, as might be expected in so densely-populated a country, are high. The best sugar lands are valued at $150 an acre; tobacco lands from $60 to $75 an acre; fruit lands from $40 to $50 an acre; pasture lands from $15 to $20 an acre; and hill lands, suitable for coffee, from $10 to $15 an acre. It is expected that within three years the island will have a complete system of well-built principal highways, and then short lateral roads will be built at comparatively small expense.

Geographical Bibliography of Chile.—An *Ensayo de una Bibliografía Histórica i Jeográfica de Chile*, published in Santiago last year, will be very helpful in studying the history and geography of that country. The authors are Nicolas Anrique R., and L. Ignacio Silva A.,and their work has been received with special favour by their countrymen. The Geographical Bibliography is introduced by a chapter on the physical geography of the Republic, which is of much value as an authoritative treatment of the subject; it occupies 49 pages. The bibliography includes 1,565 geographical titles, arranged under 17 subject-heads, with notes under many of the titles giving additional information. The systematic arrangement, according to subject and an index of authors, makes it easy to find any work included in the list.

AFRICA.

The Outlet of Victoria Nyanza.—Mr. R. B. Buckley says in *The Geographical Journal* (April, 1903) that though many rivers and streams flow into the Victoria Nyanza the only outlet is the Nile at Ripon Falls, on the north central coast. The catchment basin of the lake is about 95,000 to 100,000 square miles, and the rainfall

is assumed to be about 30 inches a year; but only a small part of this water passes over Ripon Falls to form the Nile. The falls may possibly draw off from the lake sufficient water to lower it 9 inches or a foot in a year, but the evaporation and absorption must be at least 6 or 8 times as much as this. Ripon Falls might better be described as rapids. There is a rocky barrier of hornblende-schist, like an embankment, across the channel where the Nile issues from the lake. This barrier is perhaps 10 to 12 feet above the ordinary lake level, but it is broken in three places by gaps, through which the water rushes. The barrier from shore to shore is perhaps 1,200 feet long, and the three gaps in it are probably less than 300 feet, but they have never been measured. The water of the lake, above the barrier, is about 14 to 15 feet above that in the river below. The depth of water, as it rushes through the gaps, probably does not average more than 6 to 8 feet. Mr. Willcocks gives the minimum discharge of Ripon Falls as 25,000 cubic feet per second, and the maximum as 30,000 cubic feet; but even 30,000 cubic feet per second would draw only one twenty-fifth part of an inch off the entire surface of the lake in one day, or about one and one-fourth inches in a month.

Great Britain's Treaty with Abyssinia.—The treaty between Great Britain and Abyssinia, signed at Adis Ababa on May 15th, 1902, fixing the boundary between Abyssinia and the Sudan, includes two provisions which will be of great value to Egypt. In the first place, King Menelek authorises Great Britain to extend a part of the Cape to Cairo Railroad through the western region of Abyssinia; in other words, the railroad will be built from Khartum up the valley of the Blue Nile into Abyssinia, and then south across the southwest corner of that kingdom, to or near the west coast of Lake Rudolf, and then southwest to Uganda. In this way the great region of swamp and sudd, supposed to be about 12,000 square miles in extent along the upper part of the White Nile, will be avoided. It was found that it would be very difficult, if not impossible, to build the railroad through this region. It will be a great advantage to construct the road through the more healthful country to the west, which has promise of commercial development.

King Menelek also agreed not to construct or permit the construction of any works on the Blue Nile, Lake Tsana, or the Sobat River that would tend to hinder or diminish the flow of their waters to the Nile, unless with the consent of the British and Indian Governments. Egypt thus secures the full use of the rich, muddy

waters of the Blue Nile, which, to a greater or less extent, might otherwise be retained for irrigation along the upper valley of the river, where there is an important amount of arable land.

EXPLORATION OF LAKE CHAD.—*La Géographie* (March, 1903) says that since the overthrow of Rabah and the establishment of French influence in the country of Kanem, on the northeast side of the lake, Lieut.-Col. Destenave and his officers have been engaged in scientific explorations of Lake Chad and the region of the Shari River. The form of the lake, as mapped, has been considerably modified by their surveys. The islands in the west have been accurately mapped. Most of the islands, however, are towards the eastern shores, and form two great groups—the Kuri archipelago, in the large southeastern extension of the lake, where the Bahr el Ghazal flows into the Chad; and the Buduma archipelago, which skirts the coast of Kanem north of 13° 30′ N. lat. About 19,000 persons originating in Kanem live on the Kuri islands. They are Mohammedans, and went to the islands to escape the attacks of nomads. They live by cattle and millet raising and the fisheries. Twenty-six of the Buduma islands have a population of about 17,000 souls. They say they came from Sokoto three centuries ago. They do not intermarry with their neighbours, and each island seems to be in all respects independent of the others. The inhabitants live on milk and millet, but do not fish. The French have taken possession of all these eastern islands, most of which are low and sandy. The islands have about 80,000 head of cattle.

NACHTIGAL'S JOURNEY TO WADAI.—Le Comité de l'Afrique Française has begun the publication of a complete translation into French of Nachtigal's account of his explorations in Wadai. This famous German explorer spent six months of 1873 in the study of that region, till then almost wholly unknown, which forms the extreme eastern part of the Central Sudan. These explorations concluded Nachtigal's great work of seven years in the Sudan. French colonial expansion has now reached the border of Wadai, and for this reason it is intended to place before the French public the most complete treatment of that country in all its aspects that has yet been published. The first instalment is in Supplément 3 (*Renseignements Coloniaux et Documents*), which accompanies the March number of the *Bulletin Mensuel.* The translation will fill several supplements.

The Livingstone Memorial.—Mr. Alfred Sharpe has informed *The Geographical Journal* (April, 1903) of the completion of the monument erected to the memory of Dr. Livingstone on the site of the great explorer's death. The work has been excellently carried out by Mr. Codrington. It is made of well-burned bricks, thickly coated with cement. There are no flat surfaces on which rain can lodge, so that it may be expected to last for many years. The monument bears a tablet, on which is recorded the fact that Livingstone died on that spot. The sum of money remaining after completing the monument will be expended in the erection of a native hospital, to be known as the "Livingstone Memorial Hospital," at Fort Jameson, the European settlement nearest to the spot where the explorer breathed his last.

Fisheries of the Cape of Good Hope.—For a number of years the Government of Cape Colony has been studying the fisheries around the coasts, with a view to securing larger supplies for the home market, the present yield not keeping pace with the demand. A report on the progress of this work, made annually by the Marine Biologist, and published by the Agricultural Department, is devoted largely to the researches of a small Government steamer, which hunts for new fishing areas and makes physical observations as to temperature, currents, the nature of the sea floor, and other facts which affect sea life. In 1898 a large deep-sea fishing area was discovered near Mossel Bay, over a part of the Agulhas Banks. Further studies since that time have confirmed the first impression that in extent of fishing grounds and the quantity and quality of the fish this area of about 500 square miles is likely to become the most important source of the fish supply for the colony. Mossel Bay is on the south coast, about midway between Cape Town and Port Elizabeth, or 200 miles from the nearest market. In that warm region, with ice at about $10 a ton, the expense of getting fish to market is important; but, by returning to the sea all the fish caught, excepting soles, which bring the best price, the new fishing grounds are now being turned to good account.

Population of Madagascar in 1902.—The population of Madagascar (Census of 1902) is 2,501,691 natives and 8,906 Europeans and other foreigners. The largest town is the capital, Tananarive, with a population of 51,620 natives and 906 foreigners. The largest foreign population is at or near the ports, the Province

of Tamatave having 2,175 foreigners; the Territory of Diego Suarez, 1,655; and the Province of Majunga, 1,213.

CLIMATE OF GERMAN EAST AFRICA.—One happy result of the growth of European "spheres of influence" in Africa is the increase in our scientific knowledge of the continent which is now less and less properly called dark. Among the notable scientific advances which are being made in equatorial Africa there is perhaps none which interests a larger body of persons than the progress in an understanding of the climatic conditions, for the future development of these African provinces depends very largely upon the possibility of their occupation, at least to some slight degree, by foreigners, and upon the kinds of crops which may successfully be grown there. The contributions to African climatology in English, French, and German are increasing rapidly in number, and all of them are of great value, and of general interest.

One of the latest of these studies was presented to the German Colonial Congress held in Berlin in October last (H. Maurer: "Das Klima von Deutsch-Ostafrika," *Meteorologische Zeitschrift*, XIX, 1902, 543). German East Africa is one of the most interesting portions of Africa, in that it lies between the equatorial belt of calms, in the northwest, and the southeast trade belt of the southern hemisphere, with the district of the northeast monsoons in the northeast. During the months from June to October the winds blowing towards the barometric equator to the north are southeast and south. These winds, coming from higher latitudes, are dry, except where they are forced to rise over mountains, and this is, therefore, the dry season over most of the district. In the five months June to October there is very little rainfall, months without any precipitation being of fairly frequent occurrence. The diurnal range of temperature is naturally large under the clear skies of this season; even on the coast it has reached 32° at Lindi. Dew is of almost daily occurrence, and supplies vegetation with needed moisture. Where the southeast trade is forced to ascend mountains, as in the case of the mountains on the south and east, near the ocean, there is rainfall, which is of great importance to the plantations in Usambara. During the summer months the northeast monsoon prevails over German East Africa, and in the intervening periods there are, as elsewhere, light variable winds and rains, which in some places last for two months (December–February). In the northeast of the colony, however, the northeast monsoon is very strongly developed, and brings a well-marked dry

season in Usambara and in the Kilimanjaro district. Here, then, are two rainy and two dry seasons, the first rainy season coming in November, and the second in March–May.

As regards temperature, the greater portion of the colony has its hottest weather before the summer rains, for during the latter season the cloudiness causes a reduction in the temperature. This type of temperature distribution is known as the *Indian* type. In the northeastern portions, however, where the rains stop in summer, the maximum temperature comes in February, about two months after the solstice, which gives the *European* type. In the northwestern corner, where the distance from the equator is only 1°, we have the *equatorial* type, mean annual range only 2°–3°; and a fairly uniform distribution of rainfall through the year; thunderstorms frequent and severe. The Victoria Nyanza has its own system of land and lake breezes. Maximum temperatures of over 100° have not been recorded. The hot nights are more oppressive than the hot days. During the hottest season on the northern coast, in December, 1897, at Dar-es-Salam, there were twenty-six consecutive days and nights during which the thermometer did not fall below 79°. These hot northeast monsoon nights are sleepless nights for the European, and they come at a time when malaria is most common. On the coast the mean temperature of the warmest month is 82.4°: that of the coldest between 72° and 75°. Even on the plateaux the temperatures are not much lower, but the mountains give some relief. Usambara (about 1,200 metres) has a mean annual of 64.4°, as against 77° and 79° on the coast.

There is great variation in the rainfall from year to year. The year September, 1896–August, 1897, gave 102 inches at Tanga, and the following year gave only 23 inches. Such fluctuations cause droughts and famines in the dry years and floods in the years of heavy precipitation. A severe famine occurred in 1898 in consequence of deficient rainfall. This extraordinary uncertainty as to the annual rainfall is a very unfortunate thing for the colony, and it happens that the infancy of German East Africa has come at a particularly dry time, as is shown by the fall in the levels of several lakes in different parts of the district. While this dry period may now be at an end, the hope for the future is chiefly to be centred on those portions of the colony which have a large mean annual rainfall and which show the least variation in the rainfall from year to year. Of these more favourably situated districts Kondeland, north of Lake Nyassa, seems to be the most promising.

R. DeC. W.

POLAR REGIONS.

Ice Conditions in the Arctic Seas in 1902.—The Danish Meteorological Institute has just published six charts of the North Polar regions showing the state of the ice in those waters for each month of 1902, from March to August inclusive. Various symbols are used to denote land floe, large ice fields, tight pack ice, open ice, bay ice and brash, and icebergs. In the larger part of the Polar domain the ice conditions, of course, are marked "unknown." The charts are accompanied by a summary of all the information received as to the ice conditions for that year. The Danish Meteorological Institute undertook the publication of this interesting annual report upon the invitation of the Seventh International Congress. The information is obtained from shipmasters, private persons, and meteorological and hydrographic establishments. It is greatly desired to increase the quantity of data, and the co-operation of every scientific man and captain crossing the Arctic seas is solicited. The charts and letterpress are bound together in convenient form for reference.

Searching for Baron Toll.—The hopes that Baron Toll and his zoologist, Birula, who started in the summer of 1902 respectively for Bennett Island and New Siberia Island, would meet again in the fall at Kotelnoi and travel together over the ice to the Lena delta have been disappointed. Birula returned alone, bringing no news of Baron Toll except that on his way north he reached Cape Visokyi (High Cape) on July 10th, 1902, and started again for Bennett Island. It now seems probable that if all went well with the explorer he spent last winter on Bennett Island. A relief expedition, consisting of six dog sledges, has started for New Siberia with supplies for Baron Toll; and Lieut. Kolchak has also left Siberia for the same purpose, with the intention of travelling over the ice, if necessary, to Bennett Island. The latter expedition was sent out by the Imperial Academy of Sciences at St. Petersburg. With two expeditions in the field not many months should elapse before news comes of the fortunes of Baron Toll.

Navigation in the Kara Sea.—Mr. A. J. Varnek, in the Izviestiya of the Imperial Russian Geographical Society (No. 3, 1902), says that in many instances vessels traverse the Kara Sea and enter the Ob and Yenisei mouths without meeting ice; at other times ice blocks the way entirely. As far back as the sixteenth and seventeenth centuries Russian merchant vessels passed into the Kara Sea

from Archangelsk and Kola, sometimes reaching the mouths of the Ob and Yenisei. These daring navigators left hardly any records, and the sea route to the Ob and Yenisei was entirely forgotten at a later period; in fact, the Kara Sea was long thought to be impassable. It was only about the middle of the last century that the Kara Sea began to be revisited. Almost yearly since 1871 trading vessels have entered the Kara Sea, and others have doubled the north end of Novaya Zemlia.

The writer says that the conditions of navigation around the north end of Novaya Zemlia are not worse than through the straits south of it, and, perhaps when the distribution of ice on the northern route is better known it will prove to be the preferable highway. There is less ice in the northern than in the southern part of the sea. The conditions for forming ice in the south are more favourable than in the north. The mean winter temperature near the shores of the Arctic Ocean is lower than in the more northern part of these waters. [This fact is also recorded by Nansen.] The influence of the cold continental climate is particularly great in the Kara Sea, surrounded as it is on three sides by land and open to oceanic influences only on the north. The Kara Sea may be successfully navigated only by going north when the ice is in the south and *vice versa;* in other words, when a vessel encounters ice in Yugor Shar it ought at once to proceed to Kara Strait, and, if it fails there, it should go farther north to Matotchkin Shar, or even around the north end of Novaya Zemlia. The article is accompanied by four maps showing the distribution of ice in the Kara and White seas and adjoining parts of the Arctic Ocean from March to September, 1901.

THE ZIEGLER POLAR EXPEDITION.—Mr. Ziegler, who intends to make another attempt to reach the North Pole via Franz Josef Land, invited the National Geographic Society of Washington to designate some one to represent the Society with a view to giving authoritative endorsement to any determinations which may be made of latitude.

The Society selected Mr. William J. Peters, one of the most experienced topographers of the United States Geological Survey. Mr. Peters will have charge of the scientific work of the expedition. This is expected to include pendulum and magnetic observations, the collection of all geographic data and special collections of natural history, etc. Mr. Peters is especially well qualified for this purpose. He has spent twenty years in charge of exploring

and expeditionary parties for the Government, all in the more remote and unexplored portions of the West. For the last four or five years he has been in charge of the topographic surveys of that bureau in Alaska, and has had wide experience with Arctic conditions. Mr. Peters is also one of the most thoroughly-equipped geodesists in the service of the Government, and any determinations which he may make of geographic positions will carry with them an authority which has rarely been possessed by similar work.

H. M. W.

THE BRITISH ANTARCTIC EXPEDITION.—The steamer *Morning*, the relief ship of the British Antarctic expedition, returned to Lyttelton, New Zealand, on March 25th, with gratifying news of the work of the *Discovery* expedition during the past year. The *Discovery* entered the Antarctic pack in January, 1902, in lat. 67°, reached the north coast of Victoria Land in safety, visited Cape Adare, Wood Bay, and an excellent harbour in lat. 76° 30′, leaving a record of the voyage at Cape Crozier on January 22d. The steamer then pushed beyond Mounts Terror and Erebus, following the ice barrier eastward, and in long. 165° it was found to turn northward, the water becoming shallow. From the edge of the barrier high snow slopes rose to heavily-glaciated land, with here and there bare and precipitous peaks. The coast-line was followed to lat. 76°, long. 152° 30′, or about 150 miles beyond the furthest point previously reached in this direction.

Returning westward, the ship put into an inlet in the barrier in long. 174°, and a sledge party examined the land as far as 78° 50′ S. Excellent winter quarters were found near Mounts Erebus and Terror, where the ship was frozen in on March 24th; and though the weather was stormy and severe, the expedition passed a comfortable winter. The lowest temperature recorded was 62° below zero. Sledging began on September 2d, one party making a difficult journey to Mount Terror; while Commander Scott, Dr. Wilson, and Lieut. Shackleton travelled south, reaching land in lat. 82° 17′ S., long. 163 W., thus attaining the furthest south ever reached by man. The conditions of travel were most trying. All the dogs died, and the three men dragged the sledges back to the ship, Lieut. Shackleton nearly losing his life through exposure and coming home invalided on the *Morning*. Victoria Land was found to be traversed by ranges of high mountains, which in 82° reached a height of 10,000 to 12,000 feet. Foothills resembling the Admiralty Range were found in long. 160°, and after ascending a

glacier an unbroken level plain was discovered at an altitude of 9,000 feet. The coast-line was seen stretching away nearly due south to at least 83° 20′ S.—about 70 miles further south than the furthest point attained.

Capt. Scott travelled 292.1 statute miles nearer to the South Pole than did Ross, and surpassed Borchgrevink's record by 238.05 miles; but when he turned back to his ship he was still 532.45 miles from the Pole. Nansen's farthest was 261, and the Duke of the Abruzzi's 239 miles from the North Pole. Many other comparisons might be given to indicate the enormous amount of work that must yet be done before our knowledge of the Antarctic is commensurate with that which we have gained of the Arctic regions.

Whether or not Victoria Land proves to be of continental dimensions, the discoveries of the expedition show that it is one of the larger islands of the world. The known north and south extent of the east coast is more than two-thirds of the length of Greenland, which now ranks first among the great islands. The results of the first year's work were large, and considerable additions may be made in the second year.

ASIA.

SEISMIC FREQUENCY AT MANILA, TOKIO, AND AGAÑA.—Observations taken in the period 1892–1897 give an average of 13 earthquake days a year at the City of Agaña, Guam. The number at Manila during the same period was an annual average of 12.4 earthquake days. The statistics for Tokio show an average of 129 earthquakes a year, but they evidently include many seismic movements that are registered only by very sensitive apparatus. In the period 1876–1891, in a total of 1,168 seismic movements registered at Tokio on such instruments, only 540 (34 a year) were so strong that their direction and intensity could be determined. The number of earthquake days at Tokio when the movement is plainly perceptible is, on an average, about 32 a year.

AMERICAN GEOLOGISTS TO VISIT ASIA.—Professors Raphael Pumpelly, W. M. Davis, and Mr. Ellsworth Huntington will visit western Asia this summer, to be gone several months, and perhaps the remainder of the year. They will cross the Caspian Sea from Baku, take the railroad to Merv and Samarkand, and return, probably, across the plain to the northwest, past the Aral Sea to Orenburg, in southeastern Russia. Professor Pumpelly has already travelled extensively in Asia. In 1861–3 he made scientific explora-

tions for the Japanese Government; in 1863–4 he conducted a private geological expedition through central, western, and northern China and Mongolia, and explored the northern coalfields for the Chinese Government; and in 1864–5 he made a journey of exploration across the Gobi desert and returned to Europe through Siberia. Professor Pumpelly, who was in London early in April, said of the proposed trip:

There have been great physical geographical changes operating through many thousands of years toward rendering central Asia more or less a desert country. These changes have produced gradual depopulation of countries that were once largely peopled with different degrees of civilization, dating back several thousand years. The object of the trip is to see whether the region offers a promising field for the study of the relation between measurable physical geographical changes and economic social and ethnographic changes, and for archæological research in connection therewith. The journey is taken under the auspices of the Carnegie Institute for Original Research at Washington.

The Climate of Baguio, Island of Luzon.—Where Europeans are called upon to live in moist tropical climates they find it highly desirable, if not absolutely necessary, to seek some relief from the continued high temperatures which prevail at sea-level by going, when possible, for part or all of the year, to some plateau or mountain station for recuperation. By so doing, continuous residence in such tropical climates is made more comfortable, and there is likelihood of escape, or of recovery, from some tropical diseases. Thus tropical mountain stations have become of considerable importance as resorts for Europeans. As Americans are now concerned with a tropical insular climate, in the Philippines, attention has naturally been directed to the possible development of a health resort in the mountains of those islands, and the plateau of Benguet, in the northwestern part of the island of Luzon, has been generally spoken of as the most likely place for such a resort. Exaggerated statements, not founded on meteorological facts, have been made regarding the use of this plateau as a means of solving the problem of acclimatization of the white race in the Philippines (see Bulletin, XXXIII, 1901, 50–51). Fortunately, the Philippine Weather Service has established a meteorological station at Baguio, on the plateau of Benguet, so that definite conclusions may soon be drawn regaring the climatic conditions, although as yet but one year's records have been discussed ("The Climate of Baguio (Benguet)," by Rev. Father José Algué, S.J., Report of the Director of the Philippine Weather Bureau, 1901–2, Part First, 4to, Manila, 1902).

Baguio is really in a valley, surrounded by low hills, which form

a chain except on the northeast, where there is a ravine through which the valley is drained. The hills range in height from 60 to 150 ft. above the level of the valley floor, and the altitude of the station is 4,777 ft. The annual march of temperature is similar to that at Manila. February is the coldest month, and April the warmest. A second minimum occurs in August, and is probably due to the heavy rainfall of that month. The difference in the mean monthly temperatures at Manila and at Baguio ranges between 12.4° and 16.2°, as is seen in the following table:

	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
Manila	77.0°	77.7°	80.4°	82.9°	83.3°	82.0°	80.8°	80.8°	80.4°	80.8°	79.0°	77.4°
Baguio	63.5°	62.1°	66.9°	70.5°	68.3°	67.2°	66.5°	64.6°	67.0°	67.6°	66.0°	64.3°
Difference	13.6°	15.6°	13.6°	12.4°	15.0°	14.8°	14.3°	16.2°	13.4°	12.8°	13.0°	13.1°

The highest monthly temperature at Baguio is below the mean temperature of the coldest month at Manila. The mean daily temperature range is 18.8° in April (maximum), and 7.5° in June (minimum).

The mean monthly relative humidities are as follows:

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
76%	79%	76%	74%	86%	90%	89%	93%	90%	83%	82%	84%

Baguio has a good deal of fog. The annual variation in the number of foggy days is directly proportional to the humidity. Except during July, August, and September, the mornings are free from fog. As a whole the mornings have more fog than the evenings. There is less cloud and rainfall at Baguio than at stations near the eastern (windward) coasts in November–February. The following table shows the mean monthly cloudiness (0–10):

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
3.6	5.1	4.6	3.8	6.8	7.4	7.0	8.9	7.3	5.0	5.3	5.7

Baguio has its dry season in January–April, as will be seen in the table of monthly rainfalls following:

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
0.6	0.57	1.46	0.32	4.02	12.55	15.43	37.03	11.90	4.95	2.52	5.47

Annual Rainfall; 96.29 inches.

It is hardly worth while to enter into a discussion of the climate of Baguio on the basis of but one year's record. But it may be noted that this station has considerably lower mean monthly tem-

peratures than Manila, and, therefore, does provide some relief from the sea-level conditions. The maximum temperatures thus far recorded at Baguio are also much lower than at Manila. Baguio appears to have less cloud than Manila, but is most cloudy during the months when it is most needed as a health resort. The former station also appears to have a large number of foggy days, and more rainy days than Manila.

R. C. DeC. W.

GENERAL.

The Effect of Climate on Racial Characteristics —In an important ethnological article on the probable character of the American race of the future ("What Shall It Be?," *Century Magazine*, March, 1903), Mr. Gustave Michaud seeks to determine the effects which the intermingling of the different European races will have in producing an American type of future generations. The three main sub-races in the Caucasian are the Baltic, the Alpine, and the Mediterranean. Of these the Baltic, which is to be found in its purest state in Scandinavia and in Scotland, occupies the British Isles, and the plain of northern Germany, and, in a more or less mixed condition, many portions of France, central Europe, and Russia. It is believed probable that this Baltic race is the result of natural selection exercised by the colder climate of northern Europe over the members of the primitive Mediterranean race who had migrated northward. Such an hypothesis serves to explain very satisfactorily many of the mental and physical characteristics of the present Baltic race. The result of living in a more rigorous climate was that those individuals perished who did not prepare for or were unable to withstand the severe winters, while the more thoughtful, the more energetic, the more ingenious, were able to survive. Thus, the posterity of the less fit relatively decreased, while that of the more fit increased, and the result was a new type, differing much from the old, and adapted for living in more rigorous climatic conditions.

R. DeC. W.

The Practical Side of Geography.—Professor W. M. Davis says, in his paper on "The Progress of Geography in the Schools" (*Yearbook* of the National Society for the Scientific Study of Education, Part II), that the practical side of geography is best taught in a well-developed course of commercial geography placed in the later years of the high school, after earlier courses on general geography in the grades and a course on elementary physiography, either in the

grades or in an early high school year. Here, if anywhere, it is important that the principles of systematic ontography, developed as they should be by collegiate and university study, ought to find application.

THE JOURNAL OF GEOGRAPHY.—The second year of this interesting and helpful publication begins with its removal to Chicago, where it will be published hereafter for the editors by Rand, McNally & Co. Professor Dodge remains in charge of the literary features, while the business management devolves upon Professor Lehnerts. The January number is filled with practical suggestions for geography teachers. Mr. Andrews' article on Australia shows how geographic problems may be studied on good maps, and how maps may be used to stimulate imagination and reflection. The mangrove tree is presented as a land-making plant. The influence of the glacial period upon the economic development of our country is a fascinating topic that may be so used in the classroom as invariably to impress upon the pupil's mind the relation of geographic environment to human progress. There are many other articles and notes, economic geography being particularly well represented. The *Journal of Geography*, in devoting itself to the interests of pupils of geography in the elementary, secondary, and normal schools, occupies a field of special usefulness.

NEW MAPS.

THE UNITED STATES.—Geologic Atlas of the United States.

No. 72. Charleston, W. Va. Folio. Area 938 square miles, extending from lat. 38° to 38° 30′ and from long. 81° 30′ to 82°. This quadrangle lies in the heart of the Appalachian coal basin, and its topography is of the type which characterizes the basins where the rocks are comparatively soft and undisturbed.

No. 73. Coos Bay Folio. Oregon. Area, 640 square miles, between parallels 43° and 43° 30′ N. lat. and 124° W. long. and the Pacific Ocean. Among the foot hills at the western base of the Coast Range. The country is a dissected platform in which the flat-topped hills are the remnants of what were originally more extensive plains.

No. 74. Coalgate Folio. Indian Territory. Area 980 square miles, between the parallels 34° 30′ and 35° and the meridians 96° and 96° 30′. The larger part of the quadrangle lies in the territory of the Choctaw Nation. The southern half is a nearly level plain, but the large streams of the northern half have deeper and narrower valleys. Mineral resources: coal, limestone, sandstone, and clay.

No. 75. Maynardville Folio. Tennessee. Area 963 square miles, between the parallels 36° and 36° 30′ and meridians 83° 30′ and 84°. The edge of the Cumber-

land plateau crosses the northwest corner, the remainder of the quadrangle being a part of the Great Valley of the Appalachians. Resources: bituminous coal, red hematite, zinc, lead, marble, building stone, brick clays, road metal, farm lands, timber and water power.

No. 76. Austin Folio. Texas. Area 1,030 square miles, between parallels 30° and 30° 30′ and meridians 97° 30′ and 98. A diversified surface of hills, rolling plains and level areas, part prairie and part woodland. Resources: building stone, brick clays, lime, cement, building sand, flint, road metal, artesian waters, soils, some deep and rich, others thin.

No. 77. Raleigh Folio. West Virginia. Area 944 square miles, between parallels 37° 30′ and 38° and meridians 81° and 81° 30′; lies on the southeastern margin of the Appalachian coal basin, for the most part in the drainage basin of the Kanawha River. Coal mining is the chief industry.

No. 78. Rome Folio. Georgia-Alabama. Area 986 square miles, between parallels 34° and 34° 30′ and meridians 85° and 85° 30′. The quadrangle lies in the Great Appalachian Valley. The most important mineral resources are iron ore, roofing slate, lime, building stone and bauxite, most of this mineral in the United States coming from the Rome quadrangle. The most fertile areas, excepting the river bottoms, are underlain by the Chickamauga limestone.

No. 79. Atoka Folio. Indian Territory. Area 986 square miles, between parallels 34° and 34° 30′ and meridians 96° and 96° 30′. Most of the quadrangle is in the Choctaw Nation, and embraces the Ouachita Mountain, Arkansas Valley, Arbuckle Mountain, and Red River Plain topographic types. Resources: coal (worked to some extent), granite, limestone, sandstone, and clay; and stony grazing, fertile river bottom and black marly, upland soils.

No. 80. Norfolk Folio. Virginia-North Carolina. Area 1,913 square miles, between parallels 36° 30′ and 37° and meridians 75° 30′ and 76° 30′. The quadrangle lies wholly within the Coastal Plain province, and includes the larger part of the Dismal Swamp. The soils vary from pure sand through sandy loam and clay to swamp muck. Under the larger part of the area the basal beds of the Columbia formation contain water which supplies hundreds of shallow private wells and a portion of the city water for Norfolk and Portsmouth.

No. 81. Chicago Folio, embracing four sheets or quadrangles, the Chicago sheet on the northeast, the Riverside sheet on the northwest, the Calumet sheet on the southeast and the Desplaines sheet on the southwest. About 785 square miles of the area shown are land surface and the remaining 107 square miles are in Lake Michigan.

No. 82. Masontown-Uniontown Folio. Two adjacent quadrangles chiefly in Fayette Co., southwest Pennsylvania.

No. 83. New York City Folio, including the Paterson, Harlem, Staten Island and Brooklyn quadrangles. (To be specially noticed.)

No. 84. Ditney Folio. Indiana. Covering a part of southwestern Indiana, including most of Pike County, Spencer, and Dubois Counties.

No. 85. Oelrichs Folio. South Dakota-Nebraska. Area 871 square miles, between parallels 43° and 43° 30′ and meridians 103° and 103° 30′. Both Black Hills and Great Plains topography appear in this quadrangle. Grazing is the chief industry of the semi-arid region. An artesian water sheet shows the area that will probably yield flowing and pumping wells.

No. 86. Ellensburg Folio. Washington. Area 820 square miles, between parallels 46° 30′ and 47° and meridians 120° 30′ and 121°, just south of the geographic

centre of the State and including the border land between the Columbia Plain and the Cascade Range. No metalliferous ores or coal have been found. The agricultural lands are chiefly confined to the alluvial areas.

MARYLAND.—Three maps of Cecil Co. Accompanying Vol. II (Cecil County) of the County Series, dealing with the physical features of the several counties of Maryland. Scale, 1:62.500, or 0.9 statute miles to an inch. Maryland Geological Survey in co-operation with the United States Geological Survey, 1902.

The maps are devoted respectively to (1) topography (contour intervals 20 feet) and election districts, (2) geological formations, and (3) agricultural soils, in which the State Survey had the co-operation of the United States Bureau of Soils.

Two maps of Garrett Co., Maryland. Accompanying Vol. III (Garrett Co.) of the County Series. Scale, 1:62.500, or 0.9 statute miles to an inch. Maryland Geological Survey in co-operation with the United States Geological Survey. 1902.

One map shows the election districts and topography; the other shows the geological formations and agricultural soils.

NOVA SCOTIA.—Map of Nova Scotia. Scale about 7.5 statute miles to an inch. Published by order of the Government of Nova Scotia. A. & W. Mackinlay, Halifax. 1902.

The usefulness of the map is enhanced by the fact that it gives an important amount of economic detail. Railroads are shown with special prominence and all the main wagon roads are laid down. The coal areas, which surpass the fisheries in value of production, are shown, by shading, from New Brunswick to the eastern edge of Cape Breton Island. The iron ore fields are similarly indicated, though their small production, as yet, is not commensurate with their large area. Nova Scotia produces an important amount of limestone, but whether it is conveniently placed near coal and iron centres, where it is needed in the manufacture of pig-iron, does not appear from this map. All places where gold has been found are indicated, and also the larger forest regions, as well as the cable lines and ocean routes, with distances to leading American and European ports. The cartographic work was done by the map house of George Philip & Son, Ltd., London, England. The clear definition of all details and the large amount of information make the map most noteworthy; but on an economic map of so large a scale many more facts of great interest might have been inserted without crowding. The chief fishing ports, for example, might have been indicated on this large map of a small region whose fisheries product was worth $9,000,000 in 1901; and also the great apple-growing districts that are famous for the quality of their fruit and the amount of their exports.

CHILE AND ARGENTINA.—Carte Générale de la partie méridionale de la République Argentine et du Chili. In 3 sheets, scale, 1:1.500.000, or 23.6 statute miles to an inch. By F. P. Moreno, Director of the La Plata Museum and expert representing Argentina in the Chilean–Argentine Boundary Settlement. *Annales de Géographie*, No. 61. 1903. Paris, Librairie Armand Colin.

A comparatively large-scale map, showing the boundary between Argentina and Chile according to the claims of the two Governments and as fixed by the British Arbitration Tribunal on November 20, 1902. The topography and hydrography are founded upon the fine maps for which special surveys were made as a basis for the delimitation of the boundary.

CHILE AND ARGENTINA.—Grenze zwischen Argentinien und Chile nach dem Schiedsspruch vom 20 Nov., 1902. Scale, 1:2.500.000, or 39.4 statute miles to an inch. By Dr. H. Steffen. *Petermanns Mitteilungen*, No. 1, 1903. Gotha, Justus Perthes.

This map shows the extent of the claims of both countries as well as the definitive boundary as decided upon by the British Tribunal. Both this map and that mentioned above will be very useful in the preparation of new Atlas sheets.

AFRICA.

MADAGASCAR.—Madagascar. Scale, 1:1,500.000, or 23.67 statute miles to an inch. Ministry of the Colonies. Paris, 1902.

No country is now doing more for the mapping of its colonial domain than France. The work is in charge of the Colonial Geographic Service of the Ministry of the Colonies, and a large part of the information given in the maps now being issued is the result of surveys and explorations by officers of the army and navy and others officially connected with the colonial service. The work of many private explorers is also incorporated in these maps, which will be widely used by cartographers for the improvement of their atlas sheets of regions which hitherto have yielded inadequate cartographic material. This large map of Madagascar is one of the best of these products, inasmuch as the Government surveys of the past three years have made it possible to present a large amount of accurate topographic data. Tints are used to show heights.

FRENCH NEW GUINEA.—Carte de la Guinée Française. In four sheets. Scale, 1:500.000, or 7.8 statute miles to an inch. Ministry of the Colonies, Paris, 1902.

The information includes the position of trading stations, caravan routes, waterfalls, rapids, sand banks, telegraph lines, etc. The hydrographic features are clearly presented, but little attempt is made to show topography. The map will serve the needs of these early days of the development of that region.

CARTOGRAPHY IN 1900–1901.

L'ANNÉE CARTOGRAPHIQUE. Supplément Annuel à toutes les publications de Géographie et de Cartographie. Douzième supplément, contenant les modifications géographiques et politiques des Années 1900–1901. Trois feuilles de Cartes, avec texte explicatif au dos. Produced under the direction of F. Schrader, Librairie Hachette et Cie. Paris, 1903.

This useful annual summarizes, in a series of maps, the most noteworthy changes and additions that have been made to the maps by explorations, surveys, new boundaries, railroad extension, and other geographic, political, and economic modifications. The sheet devoted to America in the present number shows the areas covered by topographic and geologic surveys in the United States and Canada, a hypsometrical map of Honduras after Sapper, fine map in the *Zeitschrift* of the Berlin Geographical Society, and a map of the Eastern Cordilleras of Bolivia, according to the explorations of Pando and Conway. The Africa sheet shows the progress in railroad building throughout the continent, and the most noteworthy recent explorations. The Asia sheet gives prominence to the explorations of the Kozloff expeditions and to engineer Parsons's preliminary survey of a railroad route through the almost unknown region in China between the Yangtse River and Canton.

ATLASES.

STIELER'S HAND-ATLAS. Neue Neunte Lieferungs-Ausgabe. 100 Karten in Kupferstich. 15 und 16 Lieferungen. Gotha: Justus Perthes. Price 60 pf. for each part containing two map sheets.

This double part contains four sheets: Nos. 32 aad 33 are the northwest and northeast sheets of the Vogel 4-sheet map of the Iberian Peninsula, revised by O. Koffmahn, for this edition. Scale, 1:1.500.000, or 23.6 statute miles to an inch. The cartographic detail has required little change since the last edition, but the additional clearness imparted to nomenclature, provincial boundaries and mountains by the new process of production is noteworthy. No. 83 is Habenicht's Map of West Canada. Scale, 1:7.500.000, or 118.3 statute miles to an inch. The new delineation of Athabasca, Reindeer, and other lakes, and of the drainage to Chesterfield Inlet, since the revision of 1896, shows that important work still remains for the explorer in Canada's vast domain. No. 85 is a summary map of the United States and Mexico on a scale of 1:12.500.000, or 197.2 statute miles to an inch. This is an innovation in the Stieler Atlas, which has not heretofore shown on one sheet the geographic relations of our States and Territories. The number of square kilometers in areas bounded by 5 degrees of latitude and longitude is indicated.

SPAIN AND PORTUGAL. Espagne et Portugal en 4 feuilles (Feuilles nord-ouest et sud-est). Scale 1:1.250.000, or 19.7 statute miles to an inch. Sheets 17 and 20 in the Atlas Universel de Géographie. January, 1903. Paris, Librairie Hachette et Cie.

The four sheets of this superior map of Spain and Portugal have now been published. The last sheet (20) is accompanied by a list of the numerous sources of information which were used in this fine work of compilation. This is the largest Atlas map of the Iberian Peninsula yet produced. The scale permits a detailed and graphic delineation of topographic features.

THE LANGUAGES OF MEXICO.

BY

CARL LUMHOLTZ.

My article on the Huichol Indians of Mexico in the BULLETIN for February, 1903, begins with some remarks about the tribes and languages in Mexico, too general in their character to be left without explanation.

The large territory comprising the Republic of Mexico is inhabited by native Indians, by descendants of the conquering Spaniards and other whites, and by Mestizos, or a mixture of Indians and whites. The negroes are so few in number that, to use the expression of the late Mexican Minister to the United States, D. Matias Romero, it is not worth while speaking of them. So far as I remember, I met, during my five years of travel in that

country, with only one negro, and he was an American, speaking English.

The greater part of the population of Mexico lives on the elevated plateau, while the unhealthy coast regions are the least populated. It may be said that mestizos predominate in the northern part of the country and pure-bred natives in the southern. Among the States where pure-blooded Indians are found in the greatest number may be mentioned Guerrero, Oaxaca, and Chiapas.

How great this Indian population is, and what the proportion of its constituent parts, we do not wholly know. In a new country, however progressive, everything cannot be expected at once. The configuration of the country, the want of inter-communication, and other circumstances combine to make accurate census-taking very difficult. In the remoter districts great numbers of the Indians keep away from the census-taker, out of distrust and superstitious notions, as well as from the fear of being pressed into military service.

The total population of Mexico in 1900 was (according to the Almanach de Gotha, 1903) 13,604,923. In a catalogue of the Anthropological Department of the National Museum of Mexico, presented to the Eleventh Meeting of the Congress of Americanists in the City of Mexico in 1895, Garcia Cubas makes the following estimate:

19	per cent.	whites..............	1,985,117	individuals.
38	"	natives of pure blood,	3,970,234	"
43	"	mixed blood.........	4,492,633	"
		Total............	10,447,984	"

Though obsolete, these figures nevertheless give some idea of the proportions.

Thus by far the greater part of the Mexican population is Indian. The ethnic and psychical unity of the native American race does not preclude much diversity, and we find in the continent an astonishing number of tribes, languages, and dialects.

Humboldt gives a list of over two hundred tribes on the Orinoco and its affluents, but he despairs of offering a classification of the 80,000 natives left at the time of his visit in a territory a little larger than France. He says: "*Un voyageur ne peut offrir des travaux achevés ; ce que l'on a droit d'exiger de lui, c'est de donner avec candeur les matériaux tels qu'il les a recueillis sur les lieux.*" *

* Voyage aux Régions equinoxiales du Nouveau-Continent (Relation historique). Tome III. Paris, 1825. Page 172.

The natives of the American continent have been less exposed to foreign influence than those in other countries. Much originality may yet be found among the tribes. This is the reason why the New World is such a prolific field for anthropological research, and why the German ethnologist, Ratzel, declared (I am not able to quote his exact words) that the light which the future will be able to throw on the early development of mankind will come through researches in America.

The tribes of Mexico do not, as a rule, intermarry, and generally do not know of the existence of other than the neighbouring tribes, who have names for each other often all but complimentary. The territory of a tribe is the world to its members. The want of solidarity among the Indians, even within the same tribe, struck me much while in Mexico. Even if I were accepted as *persona grata* in one part of the tribe, I had to begin afresh with explanations wanted about myself and my purpose as soon as I crossed a dividing river or ridge. There are constant quarrels between the different districts or sections, and, as I have explained elswhere *:

> It is not too much to say that no one district would care much if the "neighbours" (the Mexicans) were to gobble up all the rest of the tribe's domain so long as its own particular territory remained intact. Still less does one tribe concern itself with what is going on beyond its borders. This, the usual condition of primitive society, no doubt explains why it was comparatively easy for the Spaniards to conquer the Indians of Mexico.

Though Christianity during the centuries following the Conquest apparently prevailed among the tribes of Mexico, it is a fact that in the more remote parts, difficult of access, numbers of Indians still keep up their ancient beliefs and rites. It is also a fact of daily observation that, willing as an Indian is to accept the Christian doctrine, he never gives up his own religion. Only when he loses his land is he thoroughly emancipated from his aboriginal state, becoming a servant of the whites, and losing his native language. In Mexico, as elsewhere, the advance of civilization is breaking down the institutions and religions of the natives. But the diligent explorer may yet find in various parts of the country aboriginal customs and rites, or, at least, a vivid record of them; aboriginal religions, including much symbolism, may yet be definitely learnt, not to speak of the native languages, songs, and folk-lore.

Spanish is the language of the country. Most of the Indians speak it, though imperfectly. It would be impossible to find any

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* Unknown Mexico. Vol. II, page 263.

tribe in Mexico where Spanish was unknown, although many individuals, mostly women and children, do not speak it, as, for instance, is the case among the Huichols.* The monks who followed the conquering soldiers, as well as later missionaries, gathered vocabularies from most of the tribes, compiled grammars and even prepared books and dictionaries in many of their languages. Even at the present time books are printed in Mexico in Mexican native languages.†

No one of these linguistic families is of equal extent and importance with the Nahuatlan, more familiarly known as the Aztecan, which includes a large number of languages and dialects. By including what Orozco y Berra calls the Opata-Tarahumar-Pima family (Buschmann, Gatschet, Brinton, Leon), the Nahuatlan family, in its northern and southern extension, reaches from the southern part of Arizona down into Central America. Students of Aztecan are enthusiastic about its refinement of style.

In Yucatan the Maya is spoken, alongside of Spanish, the Mexicans finding the native tongue a necessity.

The Indian languages have enriched the Spanish of Mexico with many new words: as *metate*, grinding stone; *mecate*, rope; *mescal*, a kind of brandy; *coyote*, prairie-wolf; *chile*, Spanish pepper; *jacal*, hut or shed; *tecolote*, owl, etc., etc.‡

The first classification of the Indian languages of Mexico we owe to the distinguished Mexican ethnologist, Orozco y Berra.§ He assumes eleven linguistic families, comprising 35 languages and 69 dialects. Besides, he gives sixteen languages that he is unable to classify. According to this authority, there should thus be 120 languages spoken to-day in Mexico, and if to these are added the 72 extinct languages which he mentions, there were spoken about the time of the Conquest 182 languages. The Mexican philologist Francisco Pimentel‖ augmented this list. Many lists of Mexican languages have been compiled since then, and valuable work has been done in Mexican linguistics, both by Mexicans and

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* The Statesman's Year-Book for 1903 gives the natives descended from ancient Indian tribes and speaking little or no Spanish as numbering 1,908,707 in the year 1895.

† *See* Recent Mexican Study of the Native Languages of Mexico. By Prof. Frederick Starr, Anthropological Department, University of Chicago. 1900.

‡ *See* Apuntes para un catálogo razonado de las palabras Mexicanas introducidas al castellano. Por Eufemio Mendoza. México. 1872.

§ Geografía de las lenguas y Carta etnográfica de México. Por El Lic. Manuel Orozco y Berra. Mexico. 1864.

‖ Cuadro descriptivo y comparativo de las lenguas indígenas de México. 3 vols. 2a Edición. Mexico. 1874.

foreigners. To enter into details would, however, carry me beyond the scope of the present article. Classifications have lately been given by Prof. Otis T. Mason* and Prof. Cyrus Thomas.†

The most recent attempt was made by Dr. Nicolas León.‡ His classification, communicated to me April 16th of this year, assumes fifteen families:

1. Yuman.	8. Coahuiltecan.
2. Shoshonean.	9. Othomian.
3. Serian.	10. Zoque-Mixean.
4. Athapascan.	11. Totonacan.
5. Tañoan.	12. Chapanecan.
6. Maratinian.	13. Tarascan.
7. Nahuatlan.	14. Mixteco-Zapotecan.
15. Maya-Quichean.	

This work is accompanied by an ethnographical map containing boundaries of the families only. The author has wisely refrained from drawing boundaries of the languages. It would have been difficult to make any changes from those given in the map of Orozco y Berra. Very extensive explorations are required to make such delineations at all trustworthy.

I am convinced that there may yet be discovered new languages or dialects in Mexico, as, for instance, in the remote and unhealthy part of the State of Guerrero. On the other hand, there can be no doubt that future researches will be able to reduce the number of linguistic families. Dr. Leon thinks that Othomi, Maya-Quiche, and Nahuatl will be found to be the three mother tongues of Mexico.

I append the latest statistics at my disposal in regard to the number of individuals representing the linguistic families of Mexico. It was compiled by Garcia Cubas, and is to be found in the catalogue of the Anthropological Department of the National Museum of Mexico, 1895, cited above. The classification of this authority is somewhat different from the one given by León:

Mexican (Nahuatlan)	1,750,000
Othomian	704,734
Mixteco-Zapotecan	580,000
Maya-Quichean	400,000
Tarascan	250,000

* In *Mexico*, a geographical sketch, compiled by the Bureau of the American Republics. Washington. 1900.

† American Anthropologist, Vol. IV, April–June, 1902.

‡ Familias lingüísticas de México. Museo Nacional de México. México. 1902.

Totonacan	90,000
Opata-Pima-Sonoran	85,000
Zoque-Mixean	60,000
Chontalan	31,000
Apachean	8,000
Matlalzingan or Pirindan	5,000
Huavean	3,800
Guaicuran or Cochimi-Laimonan	2,500
Serian	200
	3,970,234

GEOGRAPHY IN THE UNIVERSITY OF CHICAGO.

The University of Chicago has established a Department of Geography, and Professor Rollin D. Salisbury, of the Department of Geology, has been placed at its head. The arrangement between the Departments of Geology and Geography is such that Professor Salisbury retains his connection with the former, as heretofore, at the same time that he assumes the headship of the latter. The close connection of the two departments appears from the fact that Professor Salisbury will also act as head of the Department of Geology when Professor Chamberlin is not in residence, and Professor Chamberlin will act as head of the Department of Geography in Professor Salisbury's absence.

The Department of Geology has heretofore offered courses, both elementary and advanced, in Physical Geography, and elementary courses in Meteorology. Other courses of a geographic character have been offered by other departments, notably Geographic Botany, by the Department of Botany; Zoögeography, by the Department of Zoölogy, and Commercial Geography, by the Department of Political Economy. These courses will continue to be given, as heretofore, by these several departments, except that Meteorology will be under the auspices of the new department. The new department will not duplicate the geographic courses already given, but will, at the outset, provide courses which supplement those already established. The immediate aim of the new department will be to occupy the ground intermediate between Geology and Climatology, on the one hand, and History, Sociology, Political Economy, and Biology on the other. The courses offered at the outset will be those for which, within this field, there is greatest demand.

John Paul Goode, Ph.D., in charge of the work of Geography in the Wharton School in the University of Pennsylvania, has accepted an assistant professorship in the Department of Geography, and will begin his work the second term of the summer quarter (July 27, 1903). No other appointment will be made this year. During his first year Dr. Goode will be in residence during the second term of the summer quarter and during the autumn and spring quarters. The courses which he will give during the first year will include courses on the Economic Geography of (1) North America, (2) Europe, and (3) Tropical Countries. The central theme of these courses will be the influence of the physiography, the climate, and the natural resources of these lands on their settlement, development, and present commercial and industrial status. Research courses will also be offered for advanced students.

The geographic work of the University during the coming year will include the following courses in addition to those given in the Department of Geography:

I. In the *Department of Geology.*—(1) An elementary course in Physiography each quarter; (2) a local field and laboratory course, first term, summer quarter; (3) two field courses in Geology and Geography about Devil's Lake and the Dells of the Wisconsin, in Wisconsin, one month each, commencing June 18 and July 27 respectively; (4) a course in advanced Physiography, autumn quarter; (5) a field course (for advanced students), in the Wasatch mountains of Utah and vicinity.

Other courses which, while primarily geological, are fundamental to the proper conception of the evolution of the present geography of the continents will also be given in this department.

II. In the *Department of Zoölogy.*—Courses in Zoögeography, summer and spring quarters.

III. In the *Department of Botany.*—(1) An elementary course in Plant Geography (time not announced); (2) an elementary course in Ecology, summer and spring quarters; (3) elementary and advanced courses in Field Botany, summer and spring courses; (4) advanced courses in Geographic Botany, winter quarter; and (5) a course in Physiographic Ecology, summer and spring quarters.

IV. In the *Department of Political Economy.*—Courses in Commercial Geography, summer, autumn, and winter quarters.

School of Education.—In addition to the foregoing, courses in Geography will be given by Miss Baber in the School of Education (the Normal Department of the University). These courses are planned, primarily, with reference to the needs of teachers in the grades. Miss Baber will also conduct a field course of one month's duration during the second term of the summer quarter, beginning July 27th.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, March 17, 1903.

The *Service des Côtes de France* is charged with the survey and the mapping of the coasts of continental France, as well as those of the other French coasts bathed by the Mediterranean (Corsica, Algeria, and Tunisia). It performs, for this portion of the Atlantic and Mediterranean seaboard, exactly the same duties which fall to the General Hydrographic Service for the other coasts of the globe; it traces, that is to say, the plan of the surveys to be made on our European or North African shores, it publishes the new maps resulting from these surveys, and it corrects and completes the maps already in existence by the latest information received.

The most important of these surveying expeditions within the last twenty years are: The complete survey of the Corsican coasts in 1884–1891; the hydrographical revision of the southern coast of France in 1895–1898; and the survey on a large scale, in 1896, of the lower course of streams on the northern coast of Brittany, the Arguenon, the Trieux, the Tréguier, and the Guer. Other operations during the same period were the reconnaissance of the Gironde between Blaye and the sea, that of the Loire before Paimbœuf and the Bay of Bourgneuf, that of the approaches to Brest and to Dunkerque between Nieuport and Gravelines; and in 1895 the survey of the entrance and the Lake of Bizerta, first undertaken in 1883.

It has been impracticable to organize more than a single yearly expedition for the work on the French coast; a regrettable condition, which, it may be hoped, will undergo a change for the better.

In 1900 the maps published by the *Service des Côtes* numbered 312, of which the most recent were those of the Tunisian coast, the shores of Corsica, the entrances of the Gironde, the Loire, and the Seine, the approaches of Brest, and the Lake of Bizerta. There have since appeared new charts of the southern coast of France and of Brest, while provisional charts, executed by the autophotographic process, supplied navigators at once with the most interesting results obtained by the hydrographic engineers.

Together with the new maps produced, the *Service* publishes its corrections, amounting to more than two hundred in each year, of the charts already in circulation, and besides these the volume of

the *Recherches Hydrographiques sur le Régime des Côtes*, in which are inserted the reports of hydrographic reconnaissances, and of nautical commissions, and whatever has for its object the improvement of the ports of France.

Another important section is that of the *Cartes et Archives*, which, with the *Service des Marées*, constitutes the third section of the Hydrographic Service. To this section belong the supervision of the publication and correction of charts, the furnishing of maps and nautical documents to the ports and naval stations, the purchase of foreign maps and charts, and the care and classification of the archives. It is this section, also, which brings out every two years the catalogue of French Hydrography.

The rich archives of the Hydrographic Service are subdivided into technical or *Lesser Archives* and general or scientific, denominated *Greater Archives.* The former supply the data for the construction of charts, while the Greater Archives contain memoirs and reports, manuscript and printed charts and plans, maps of the world—such as the famous Canerio of 1502—general and special maps, log-books of celebrated voyages, manuscripts of the astronomer de l'Isle, of Buache, etc. It is among these collections that M. Henry Harrisse has worked to good result.

In the *Service des Marées*, founded under the Monarchy of July and reorganized in 1886, are performed the calculations required for the *Annuaire des Marées des Côtes de France*, a publication which dates from 1839, and is still calculated in its essential parts according to the methods which Chazallon adopted from the *Mécanique Céleste* of Laplace, although there is a growing tendency to substitute for these the harmonic analysis of the tide due to Lord Kelvin, introduced into the *Service des Marées* since 1893. The *Annuaire des Marées* has published for some years a number of tables, obtained in part by means of the data of the harmonic analysis, in part (for the ports in the colonies) by means of the abridged method of Prof. Darwin;* and for some years past it is in the *Service des Marées* that the elements of the prediction of the tides have been calculated for the ephemerides of the Bureau des Longitudes, in which they have figured since the end of the XVIIIth century.

Of lesser geographical incidents since the date of my last letter may be mentioned the series of lectures organized by M.

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* It is to be noted that the *Service Hydrographique* has possessed since 1901 a Tide Predicter, identical with that of the London India Office, and made by Lord Kelvin's constructor.

Edmond Perrier at the Museum of Natural History, on the productions of our colonies, their geology, and their flora and fauna. A systematic, scientific collection of photographs illustrating the variations of glaciers, the phenomena of denudation and of erosion and the like, would have an especial value for students.

A first step in this direction has been made by the French Alpine Club in an exhibition of unpublished photographs of mountains. By the side of M. Vittorio Sella's views of the Himalayas, taken at a distance of 80 miles, were an excellent panorama of the Wildstrubel and some good views of Mont Blanc, the Alps of Savoy and of Dauphiny; very few, however, in other parts of the Alps, and few of the Pyrenees. Of the central *massif* of France there were two or three views, but not one of the Jura or of the Vosges; so that, as an exhibition of scenery in high mountain regions, the collection was very incomplete, while some of the photographs, to which premiums were awarded, were undeniably falsified. This is the more to be regretted that the idea of the Alpine Club was excellent and much of the work admirable. Future exhibitions will win the approbation of geographers, if the jury does not exclude the views of the lower mountain ranges, and if it insists, first of all, upon the scientific interest and value of the photographs.

The recent meetings of the Société de Géographie have been less attractive, from a scientific point of view, than some of those of last year; though exception must be made in favour of Dr. Sven Hedin's story of his last journey in Central Asia and M. E.-A. Martel's résumé of his subterranean explorations in 1899–1902, in France, in Spain, in Switzerland, and Belgium, etc. M. Martel established beyond question, by examples taken on the spot, the reality of the law of capture and absorption of water-courses by fissured terrains. Action must be taken at once against these captures, and among the most effective measures is reforesting. Returning to these ideas in the number of *La Géographie* for March, M. Martel does not hesitate to affirm, in a notice of the springs which are disappearing in the Department of Aisne, that

> the struggle for the means of quenching thirst, already so sharp from the sanitary and microbian point of view, will become sharper, even as regards quantity alone, in a relatively near future. . . . . It may be predicted that our planet will be parched before the sun is extinguished; and we must seek for the means of retarding this fatal process of evolution.

In an impressive address before the Alpine Club, Dr. Jacot-Guillarmod described the attempt made by himself, with three

Englishmen and two Austrians, to ascend the Himalayan peak K2, or Godwin-Austen (28,281 feet high), in Kashmir. Starting at the end of March, 1902, the party reached the Baltoro glacier (56 miles long), and, beginning the ascent at a point 12,000 feet high, attained the elevation of 23,000 feet—a little more than that reached by Sir Martin Conway and his companions in 1892, after seven weeks passed above the level of 18,000 feet. We must wait for the publication of their report before pronouncing upon the scientific value of the feat accomplished by Dr. Jacot-Guillarmod and his friends.

Of explorations in progress there would be little to note except the return of Dr. Cureau and M. Bonnassiès from the frontier of the Kamerun and French Congo, that of M. Duchesne-Fournet from Ethiopia, and the departure of M. Giraud for Martinique and Guadeloupe, if the Société de Géographie had not received sad news concerning M. du Bourg de Bozas. After having reached Lake Rudolf by way of the valley of the Omo, not without fierce fights with the savage Gallas of that region, M. du Bourg de Bozas undertook to continue his journey towards the west in a diagonal direction across the continent and to descend the Welle and the Ubangi to the Congo at Brazzaville. A report written on the Nile appeared in *La Géographie* for February under the title, *From Addis Abbaba to the Nile by Lake Rudolf*, and was hardly printed when the author's death was announced. He expired at Amadis, in the Congo Free State. His companions are on their way to the West African coast with collections and materials for a publication worthy of the young explorer, who, from the very beginning, had done honour to French enterprise.

An expedition of a different kind is projected by Dr. Charcot. He plans a voyage to the Arctic, to the exploration of which France has remained almost entirely strange, according to the following scheme: To start from Tromsö and the Loffoden Islands, to land in Spitsbergen and make collections of fossils for the Museum; then to visit Novaya Zemlya and explore it up the west coast and down the east coast, and to return by the Sea of Kara. M. de Gerlache, the commander of the *Belgica*, and several savants will accompany Dr. Charcot, and the expedition is to be made under the auspices of the Academy of Sciences and the Société de Géographie.*

Some very valuable observations have been made by M. Paul

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* It is reported that the Charcot expedition will be sent, not to the Arctic, but to the Antarctic.—ED. BULLETIN.

Girardin on the variations of the glaciers of the Maurienne and the Isère. He was charged by the Commission on Glaciers with the study of the upper valley of the Arc. He took photographs and sketched the lower extremity of the glaciers and the positions from which they have retreated. Retrogression dominates, but in certain cases there is a stationary condition or a tendency towards advance. It was between 1892 and 1902 that the higher level in the glaciers of the upper valley of the Arc seems to have been produced; a rise which has not affected all the glaciers, and has merely weakened temporarily the great negative variation in the course of which it took place.

While writing of glaciers, we may note the initiative taken by Gen. Arvers, of the 26th Division of Infantry, in his instructions to the officers of the Alpine troops under his orders, recommending them to make careful observations of the variations in the length of glaciers—a matter, as he justly remarks, of importance to the national defence. The withdrawal of glaciers has opened to the movement of troops the more elevated passes, which become much less practicable during periods of glaciation or are even wholly obstructed by accumulations of icy masses. If these circular instructions are made general, and the facts noted by the officers of the Alpine troops are transmitted to the Commission on Glaciers, that body will soon find itself in a position to publish a very complete annual collection of observations, important for the physical study of the French Alps.

Of recent publications in geographical journals I may call attention to an article by M. Camille Vallaux in the *Annales de Géographie* for January on the oscillations in the western coasts of Brittany. The different arguments adduced to support the theory of a sinking of this portion of our sea coast (the separation of the archipelago Ushant-Molène, the drowned forests of the beaches north of the country of Léon, the engulfed legendary cities of Ys and Tolente, the ruin of the city of Tréoultré, etc.) are very well explained by the action of marine erosion, which still continues at certain points.

In a recent Bulletin of the Marseilles Geographical Society, M. Henri Barré has indicated the principal facts which direct the grouping of the population in the Provençal country.

Two important works, by M. E. Doutté, on Southern Morocco have just been published; one (in *La Géographie* for March) is a collection of notes and impressions gathered in July, 1902, in an excursion to Figuig; the other, an extract from the first volume

of a work on Morocco, now in the press, relates to sacred cairns and practices connected with them. The *Annales de Géographie* published in January a letter of M. E. F. Gautier (who is now again in the Sahara) on the configuration of the regions traversed by him in 1902 as far as Timimun; he makes the remark that in the southern part of the department of Alger, with the exception of Mzab and El Golea, the country has the character of the desert (a striking contrast with the southern portion of Oran).

M. Charles Rabot, in a note published in *La Géographie* for March, makes us acquainted with the work of Lieut.-Col. Destenave's expedition to the region of Lake Chad. After completing the pacification of the country, begun by Commandant Lamy and M. Gentil, M. Destenave explored the two great groups of islands in the western Chad, as well as Kanem and the eastern shore of the lake on both sides of the Bahr el Ghazal. Detailed reconnaissances in the region of the Shari and in Wadai corroborated and completed the work of M. Gentil and his companions. The geology, the ethnography, the flora, etc., of the country were carefully studied, and the topographical work of the expedition is shown in a map of the territory extending from the Ubangi to the north of Kanem, drawn on a scale of 1 : 200,000 by Capt. Bezu. This map has been presented to the Academy of Sciences.

Another map, recently published by the *Annales de Géographie* on a scale of 1 : 500,000, is the result of six years' work—1894–1900—by M. Paul le Cointe on the lower Amazon River, between Faro and Alemquer.

The recent explorations of Messrs. Svenonius and Hamberg in Swedish Lapland are studied by M. Charles Rabot in *La Géographie*. The Swedish naturalists discovered mighty Alpine masses in a country believed, till then, to be occupied by plains, and M. Rabot emphasizes the three different aspects presented longitudinally by the territory between the Stora Lule elf (67° 30′ N. lat.) and the Lilla Lule elf (67° 00′) on one side, and between Norway and the great lakes of Sweden. In his opinion the study of the Sarjektjäkko and its glaciers, so happily concluded by M. Hamberg and his associates, is important for the physics of the globe.

Not to be overlooked is the paper of Prof. J. Brunhes, in the *Mémoires de la Société fribourgeoise des Sciences Naturelles*, on the Work of Running Waters and the Tactics of Whirlpools. Dr. John Ball's study of the Semma rapid, on the Nile, has just furnished a striking confirmation of the ideas advanced by M. Brunhes.

Henri Froidevaux.

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BOOK NOTICES.

*Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University, Vol. II, Nos. 1 and 2.** *Researches in the Central Portion of the Usumatsintla Valley, by Teobert Maler.*

The results of several expeditions undertaken by the author are here compactly set forth. The sites examined, fifteen in number, are in the States of Tabasco and Chiapas, Mexico, and the Department of Peten, Guatemala, and were visited as follows: La Reforma, Chinikihá, Cháncala, Xupa, and Lake Pethá in 1898; Piedras Negras in 1895 and 1899; El Cayo, Budsilhá, La Mar, El Chile, Anaité II, and El Chicozapote in 1897; Yãxchilan in 1897 and 1899–1900; Lake Bolonchac and San Lorenzo in 1900. In none of these sites, with the exception of Yãxchilan and Lake Pethá, had important explorations been previously made.

The work at Lakes Pethá and Bolonchac was ethnological, elsewhere archæological. The material for the former is scarce and vanishing rapidly. The few facts which Herr Maler could gather about the moribund Lacantun Mayas are of great interest. Their ancestor worship, their lack of capacity for joyfulness, their kindliness and shyness, at once make further researches desirable and fascinating. Vases of stone and clay they still use in offering to the gods and old images on the old sites. It is much to be hoped that Mr. Tozzer, now at work among this evanescent race, may help to fill up the awful gap between the builders of the great prehistoric structures and the present hut-dwellers. Prehistoric buildings are scattered all over the valleys, but on the river at Piedras Negras and Yãxchilan (or Piedras Verdes) were stately cities. Community-houses, mortuary pyramids, and temples stood on the slopes in order, usually facing in some common or regular direction. Carved friezes, lintels, and walls; painting, outside and in and on the sculpture, reminding one in colour and design of Tiryns and Crete; altars and stelæ in great numbers, were here. The carving, mostly in relief, on lintels, altars, and stelæ, resembles that from Palenque, Copan, and elsewhere; the inexperienced may say they all look alike, but the identities vanish on close study, and an infinite variety of symbolism, representation, composition, expression, colour, and technique appears. Noble gods,

* Cambridge: Vol. 1, 1901; Vol. 2, 1903. Published by the Museum.

high priests, and doughty warriors are shown in contrast to common men and women and prisoners—a contrast heightened, somewhat as in archaic Greece, by differences in size and working out.

The great fault with Mayan art is over-elaboration of dress; the figure is lost in symbols and apparel. Archaic Greek art developed into the showing of the human form with drapery as an accessory, and thus reached the highest; archaic America went the other way, and failed. One welcomes the rare, occasional approaches to the nude as seen in the statue from Budsilhá (p. 92), the statue of Ketsalkoatl from Yāxchilan (p. 161), and the head from San Lorenzo (p. 206).

There are a few slips—surprisingly few—such as the placing of Chάncala on the map to the north of the Chάncala River, and in the text (p. 14) to the south of it; again, the text (p. 24) reads that the expedition moved south or southeast, whereas it must have moved southwest. Outside of these the book is wonderfully composed, translated, and printed. The style is perfection; far from dry, it contains all the archæological data obtainable. The translators, Miss Wesselhoeft and Miss Parker, deserve praise for the elimination of German abstruseness. The eighty photographic plates are beautifully done, and are absolutely indispensable to the understanding of the text. Made with a loving taking of pains, in the most favorable sunlight or at night by magnesium light by Herr Maler, they will appeal to all who have ever taken camera or excavations in hand. Equally important are the maps, which, outside of the twisting of the points of the compass in that of Yāxchilan, are admirably clear, complete, and precise. C. P.

The Weather and Practical Methods of Forecasting It, by E. B. Dunn. 8vo, pp. viii + 356. New York, Dodd, Mead & Company, 1902.

The author of *The Weather* is already quite well known as the former Local Forecast Official of the United States Weather Bureau in New York. In this book Mr. Dunn has, as he says in his preface, "aimed to avoid all mathematical and scientific and technical terms, and to present the subject in the simplest and most popular form"; there is general, but brief, discussion of most of the subjects treated in the text-books of meteorology, and considerable attention is paid to rules for forecasting coming weather changes, both with and without the use of the daily weather map. A chapter on Climate is chiefly concerned with the question of climate in relation to diseases of the respiratory system.

It is unfortunate that a book on a subject of so great popular

interest, by a writer whose official position brought him into such prominence, should be so incomplete and so inaccurate. In the discussion of even the ordinary meteorological phenomena and processes there are frequent statements which are wholly in error, and which recall the mistakes so commonly made in the past when meteorology was in its infancy. Thus, for example, to take one striking case, the author says regarding the snow-line (page 90): *The snow limit, as observed in the mountains, is where the highest temperature of the year never sinks below 32°.* Exactly what is meant by that sentence is not perfectly clear to us. What we suppose Mr. Dunn to mean is that the snow-line is defined by the altitude at which the maximum temperature is never above freezing. This is an entirely erroneous view. The first stage in the development of the conception of the snow-line, from Bouguer to de Saussure, was dominated by the idea that snow-line and frost-line (*i. e.*, the mean annual temperature of freezing) are identical. Bouguer believed that the climatic snow-line coincides with the isothermal surface of 32°. Humboldt and Buch substituted for the mean *annual* isothermal surface of freezing the mean *summer* temperature of 32°. Alexander von Humboldt first recognized the real complexity of the problem of the snow-line in its relation to temperature, and it is now known that mean temperatures or maximum temperatures are not the only factors which control the height of the snow-line. The amount of the precipitation, and especially the amount of the winter precipitation, as snow; exposure to sunshine and to warm and dry winds; the steepness of the slopes, and the height to which the mountains rise above the region of snowfall, are all important controls. Thus it has come about that the height of the snow-line is no longer believed to be a function of the temperature alone, and to make such statements as that just quoted is simply to continue an error of many years ago.

A large number of no less great inaccuracies might be referred to; for example, the statement (pages 2 and 3) that "there is a constant circulation of air flowing from the equator towards the poles in the upper atmosphere and a counter-current which flows from the poles along the surface of the earth towards the equator." There is, however, no need to multiply these examples. *The Weather*, although the subject is popular, the book attractive in appearance, and the writer pretty generally known, because of the many serious inaccuracies which it contains can be recommended neither to the general public nor to teachers and students of meteorology.

R. De C. W.

A Geography and Atlas of Protestant Missions. Their Environment, Forces, Distribution, Methods, Problems, Results, and Prospects at the Opening of the Twentieth Century. By Harlan P. Beach, M.A., Educational Secretary Student Volunteer Movement, Fellow of the American Geographical Society, Member of the American Oriental Society. Vol. I, Geography (x and 572 pp.); Vol. II (quarto); Statistics (31 pp.), and Atlas (18 plates and index, 23 pp.). Student Volunteer Movement for Foreign Missions. New York, 1901–1903.

This work is a survey of the Protestant missionary field, primarily prepared for members of the Student Volunteer Movement for Foreign Missions. It is a very clear and practical exposition of the present distribution of Protestant missionary enterprises, and of the work they are undertaking throughout the world. The field is viewed entirely in its present aspects, the reader being referred to general and special works for historical data. Each country is first treated in its geographical, climatic, racial, and other general aspects, giving the reader a clear conception of the environment amid which the many hundreds of missionary posts are situated. This general view is followed by a statement of the missionary influences in the field, and of the work and outlook. The relegation of statistics to a section by themselves, in the quarto volume, relieves the text of a mass of figures, and renders easily accessible an immense amount of important information, every item of which may quickly be found when it is needed. The Atlas undoubtedly contains the best series of missionary maps yet published, presenting all the information relating to the subject which can be cartographically shown. The plates are the product of the superior processes employed in the map house of John Bartholomew & Co., Edinburgh; and the result is that the maps are pleasing in appearance as well as satisfying on account of their fullness and accuracy. The work is admirably adapted for the use of mission study classes in American Colleges and Theological Seminaries, and of all who are interested in missions; nor would it be easy to find a more compact and helpful atlas for the home circle.

The Alaska Frontier. By Thomas Willing Balch, A.B. (Harvard), Member of the Philadelphia Bar. Philadelphia, Allen, Lane & Scott, 1903. 8vo.

Mr. Balch's Introductory Note says:

This monograph was prepared with the object of stating briefly, but emphatically,

the title of the United States to a continuous, unbroken lisière, or strip of territory, on the northwest American continental shore, between Mount Saint Elias and fifty-four degrees forty minutes north latitude. In August, 1898, the Anglo-American Joint High Commission assembled at Quebec, and soon after Canada formally made claim to a large slice of the Territory of Alaska. . . . If the Canadian Government has any serious and tangible proofs with which to support its claims it has not yet made them public.

The question between the two countries is transferred by treaty to a Commission, or tribunal of six jurists, three to be appointed by the United States and three by Great Britain.

With the Commission it must be left, but it is not easy to see how any reader of Mr. Balch's clear exposition, supported by the cumulative evidence of the twenty-eight maps presented, can fail to accept, as proved, the right of the United States to the *lisière* on the mainland, stretching from Portland Channel to Mount Saint Elias, and extending far enough inland to exclude the British possessions from access to the coast-line above fifty-four degrees forty minutes.

The book is handsomely printed and bound, and the maps are well reproduced.

The Philippine Islands, 1493–1803. Explorations by Early Navigators, Descriptions of the Islands and their Peoples, their History and Records of the Catholic Missions, as related in Contemporaneous Books and Manuscripts, showing the Political, Economic, Commercial and Religious Conditions of those Islands, from their earliest Relations with European Nations to the beginning of the Nineteenth Century. Translated from the Originals. Edited and annotated by Emma Helen Blair and James Alexander Robertson, with historical introduction and additional notes by Edward Gaylord Bourne. With maps, portraits and other illustrations. Vol. I—1493–1529; Vol. II—1521–1569. The Arthur H. Clark Company, Cleveland, Ohio, MCMIII. 8vo.

These are the first of a series of fifty-five volumes to be published, containing English translations (and also, in some cases, the original texts) of manuscript, and printed books and documents, relating to the Philippine Islands for the 310 years beginning with the year 1493, and the Bulls of Alexander VI. to Ferdinand and Isabella, and closing with the *Estadismo*, or Itinerary, of Father Joaquin Martinez de Zúñiga in 1803.

One volume will be issued monthly until the work is completed.

The editors say, in their General Preface, that most of the material presented is now for the first time made accessible to English-

speaking readers. It is added that the aim is to secure historical accuracy, especially in that aspect which requires the sympathetic interpretation of each author's thought and intention; and to depict faithfully the various aspects of the life of the Filipinos, their relations with other peoples, and the gradual ascent of many tribes from barbarism. The volumes published are edited throughout with fidelity to this high aim.

Especially valuable is the Historical Introduction by Prof. Edward Gaylord Bourne, of Yale University (Vol. I, pp. 19–87). Those who read and meditate this Introduction will find themselves, perhaps for the first time, in possession of sound ideas as to the Spanish colonial system and the work of Spain in the Philippines.

The translations seem to be excellent, though in one place (Vol. I, p. 297) the rendering of the Spanish text has been overlooked in a foot-note. The extract of a letter from the Indies mentions three vessels under command of Magellan:

> They had been sighted off the cape of San Agustin, from which point they had run about two hundred or three hundred leagues along the coast of Brasil. There they anchored in a river which flows [*properly*, flowed] across the whole of Brasil, and was of fresh water.

The foot-note reads: "This must have been the Strait of Magellan."

Cape San Agustin is within twenty miles of Recife, and at least seven hundred leagues north of the Strait of Magellan. The river of fresh water in which the ships anchored is to be identified with the Rio de La Plata, which the writer of the letter appears to have confounded (in 1522) with the strait discovered by Magellan.

The illustrations of Vol. I are: Portrait and Facsimile Signature of Magellan; Title-page of *De Molvccis Insulis*, from the First Edition in the Lenox Library; and a Map of the Philippine Archipelago.

Those of Vol. II are: Portrait of Legazpi; Portrait of Fray Andrés de Urdaneta; Signatures of Legazpi and other officials; and the Santo Niño of Cebú (image of the child Jesus found there by Legazpi's soldiers in 1565).

TRANSACTIONS OF THE SOCIETY.

MARCH–APRIL, 1903.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, March 17, 1903, at 8.30 o'clock P.M.

President Peary in the chair.

The following persons, recommended by the Council, were elected Fellows:

Eben Sugden.
Abraham White.
Frank B. Read.
Henry Siegel.
Gustave Schirmer.
Elijah W. Sells.
Lester J. Saul.
J. O. von Schmid.
William E. Wheelock.
Henry R. Wilson.
Thomas G. Shaughnessy
Frank F. Proudfit.
George H. Proctor.
Albert S. Roe.
John Wier.
Henry L. Shippy.
Charles Pfizer.
Charles Reed.
James B. Reynolds.
E. A. Richard.
Thomas Potts.
Robert Rogers.
Charles Brodie Patterson.
Fred W. Snow.
James Tolman Pyle.
Frederick T. Steinway.
James F. Sutton.
Rudolph E. Schirmer.
Joseph J. O'Donohue, Jr.
Eugene E. Osborn.
Frederick J. Lisman.
Albert J. Pitkin.
Pierre Lorillard.
William G. Low.
Daniel W. McWilliams.
Walter McDougall.
John B. Kerr.
Victor F. Lawson.
Frederick D. Ives.
Jesse W. Reno.
Horace P. Whitney.
Arthur L. Lesher.
Gustavus Maas.
James N. Jarvie.
Russell W. Porter.
Prof. A. E. Burton.
James M. Lehmaier.
George Herrmann.
John Morris.
Francis Taylor Maxwell.
Edward W. Scott.
Miss Rebecca Harvey.
Richard M. Raven.
William Stanton Root.
Hugh L. Harrison.
Herbert L. Satterlee.
Albert Goldman.
Frank T. Fitzgerald.
Henry F. Poggenburg.
A. Wendell Jackson.

Evan Randolph.
Augustus Prentice.
Harry L. O'Connor.
Jacob Siegel.
George H. Smith.
Clinton L. Rossiter.
William I. Overstreet.
B. Sherwood Dunn.
Walton D. Mann.
Clarence H. Mackay.
Edmond H. Hamilton.
George F. Hodgman.
Charles B. Hill.
Lowell Lincoln.
Ernest L. Simpson.
Thomas T. Gaff.
Theodore P. Gilman.
Abraham Gould Jennings.
Lajos de Loczy.

The President then addressed the Society:

I have to announce that at the last meeting of the Council the Cullum gold medal was awarded to H. R. H. Luigi Amedeo, Duke of the Abruzzi, for his ascent of Mount St. Elias and his Arctic voyage in the *Stella Polare.*

For several reasons it gives me special pleasure to be able to announce this award.

I have followed the Duke of the Abruzzi both in his Mount St. Elias expedition and in his Arctic voyage with the greatest interest. His work has a quick, effective character, which is particularly attractive.

Few, perhaps, can appreciate better than I the qualities which enabled him to fit out his Polar expedition with such completeness and intelligence; the qualities which encouraged and kept up his men in their arduous and splendid journey to the highest North, and the qualities which enabled him to repair his crippled ship and bring her safely home.

Besides the personal satisfaction which his work must have brought to the Duke, his expedition, regarded from a purely utilitarian point of view, has been worth to Italy many times more than its actual cost in increased prestige.

He has forced the civilized world to recognize the fibre of which Italians are made, and there is probably not an Italian to-day, at home or abroad who is not prouder because Luigi Amedeo did what he did.

But he appeals to me in another way. He is a striking example of a young man of wealth and position, without even the incentive, so powerful with many, of making a name for himself—for he already held a proud one—urged by the manly spirit within him to devote his time and means to accomplishing something in the world, instead of wasting both in mere amusement.

We have hundreds of young men of means who might pattern after the Duke of the Abruzzi. Let them buy or hire a ship and go somewhere, and do something, or find out something. There could be no better school for all the manly qualities. There could be no better training for future responsibilities; and, if one has the money, there are few things more enjoyable than fitting out an expedition.

And if one of these young men should perchance find virgin land on which to set his foot, or should force his ship into waters that never saw the gleam of sail before, he will experience sensations different from any that civilization can give him, and will etch upon his brain pictures and impressions which will last him to his dying day.

Both on account of his successful achievements, and the shining example which he has given us, I congratulate this Society on its selection of the Duke of the Abruzzi for the award of the Cullum gold medal.

President Peary then introduced the speaker of the evening, Mr. Harry de Windt, who described the incidents of his journey from Paris to New York by land. Illustrations were thrown upon the screen.

On motion, the Society adjourned.

A Regular Meeting of the American Geographical Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, April 14, 1903, at 8.30 o'clock P.M.

Vice-President Moore in the chair.

The following persons, recommended by the Council, were elected Fellows:

William Greene Roelker.
Charles H. Mellon.
William C. Endicott.
Nathan Herrmann.
Isaac E. Gates.
Peter Cooper Hewitt.
Edward W. Humphreys.
C. H. Pepper.
John J. Donovan.
Julius Heimann.
Theodore W. E. de Lemos.
William B. Dana.
Charles J. Faulkner.
John G. Robin.
Eckhardt V. Eskesen.
Robert B. Hirsch.
Samuel P. McConnell.
James Furman Kemp.
R. D. Douglass.
William H. Ellis.
Russell R. Cornell.
Victor I. Cumnock.
Charles N. Brizse.
Grenville M. Dodge.
F. Q. Brown.
Charles Griswold Bourne.
Morgan R. Ross.
Charles L. Bernheimer.
Henry A. Caesar.
John A. Amundson.
Benjamin D. Brown.
Henry W. Schloss.
George R. Bunker.
James C. Atwater.
Harold Binney.
Frank G. Bigelow.
Edward H. Hobbs.
Joseph C. Batchelor.

The Chairman then introduced Dr. Elmer L. Corthell, who addressed the Society on the experiences of Two Years in the Argentine Republic as Consulting Engineer of the Ministry of Public Works.

Stereopticon views were shown.

On motion, the Society adjourned.

OBITUARY.

Paul Du Chaillu.

A telegram from Saint Petersburg announces the death of the famous explorer in that city on the 30th of April.

Paul Belloni Du Chaillu was of French parentage, but authorities differ as to the place and the date of his birth. His own written statement must be accepted as final. He was born in Paris, July31, 1835.

Du Chaillu's father was a trader on the west coast of Africa, and Paul's early years were passed at the Gaboon, where he was taught by the missionary Fathers. He showed great fondness for natural history, and made himself acquainted with the languages and the customs of the native tribes. He was still a very young man when he set out with a few native companions on an exploring expedition into Central Africa. From this journey, which lasted nearly four years, he returned with sixty previously-unknown species of birds, with specimens of the gorilla, and with a fund of strange information concerning the pygmy races of the great equatorial forest. His book, *Explorations and Adventures in Equatorial Africa*, published in 1861, was received with ridicule and incredulity; but, one by one, his observations and discoveries were confirmed by later travellers, and his reputation was established.

In 1863, he visited Africa again and spent two years in the explorations described in *A Journey to Ashango Land*, brought out in 1867. In 1871, Du Chaillu went to Sweden and Norway, where he lived and travelled for more than five years, studying the people and their institutions, and writing *The Land of the Midnight Sun*, published in 1881. This was followed in 1889 by *The Viking Age*, his most ambitious work.

His habits of keen observation and his lively descriptions made Du Chaillu a favourite with young readers, for whom he wrote with unwearied industry.

His buoyant and youthful temperament seemed to defy the lapse of time, and to those who bade him farewell two years ago, when he went to Russia, the news of his death comes as a thing not to be believed. His was a kindly and generous nature, steadfast and true in friendship, and without bitterness, even where he had been wronged.

Mr. Du Chaillu was a Corresponding Member of the American Geographical Society from 1860 to 1868, a Fellow from 1868 to 1892, and again a Corresponding Member for the years 1892–1903.

BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXV 1903. No. 3

NOTES DURING A JOURNEY IN GUATEMALA, MARCH TO DECEMBER, 1902.

BY

GUSTAV EISEN, Ph.D.

CONTENTS:

INTRODUCTORY.

The following notes are based upon two visits to Guatemala. The first was made in 1880 and 1881, and lasted about one year. During this time I explored, principally on foot, the northeastern, eastern, and southern parts of the Republic. My second journey was due to a special mission intrusted to me by Mrs. Ph. A. Hearst, and lasted from March to December, 1902. During this time I visited principally the western and southern part of the country. The considerable interval between my two journeys has enabled me to note many changes which have taken place as regards biological, botanical, zoological, as well as agricultural aspects—changes which must greatly be regretted by every lover of the matchless nature which Guatemala shares with the rest of Central America. It has been frequently presumed that the luxuriant nature of a tropical country would rapidly heal the wounds inflicted by man's thoughtlessness, and that an abundance of rain and sunshine would soon

replace the devastated forests, as well as re-animate them with birds and other animal life; but a careful study shows that this is not the case. In the tropics, as well as outside of these regions, the rule seems to be that nature is slow in healing the wounds inflicted by the methods which man commands, and that, here as elsewhere, what is once gone is gone forever. During the last twenty years the whole aspect of the coast region of Guatemala has completely changed. The former forests have given place to plantations. In many places these have been since deserted; but the tropical forests have not returned, and many of their former inhabitants have become extinct. Where once deep soil covered the rock, the destruction of the trees has been followed by the washing away of the soil and the laying bare of the bed-rock, just as in our own country. As a personal narrative would occupy too much space, I have here simply condensed some notes of more general interest.

The Pacific Shore-line, its Aspects, Rainfall and other Climatic Conditions.

Travelling from San Francisco, California, along the Pacific coast of the continent to Central America we pass through three distinct climatic zones. The "extra-tropical arid zone" characterises Alta and Baja California, as far down the coast as the Cape Region of the latter country. The "tropical arid zone" begins with the Cape Region of Baja California and continues as far down as the town of San Benito, near the boundary of Guatemala. The "moist tropical zone" again begins in the vicinity of San Benito, and continues southwards below the equatorial region of South America. These three zones are quite distinct one from the other, though at the points of contact the transitions are somewhat gradual.

The "extra-tropical arid zone" is characterized by dry summers, during which dense and cold fogs are only too frequent even some little distance inland from the coast. The winters, again, are rainy, as a rule without any fogs, but with heavy frosts, especially in the interior valleys back of the coast. These winter rains, which all originate from *lows* in the Pacific Ocean off the coast of Alaska and British Columbia, diminish in intensity as we go farther south. While they never fail in California proper or Alta California, they become very scant and irregular along the coast of Baja California. As far down as San Quentin these rains seldom fail, but south of that point they become scarcer and lighter, until at Magdalena Bay they occur only once in three or four years. A characteristic of these rains of the extra-tropical arid zone is that

they are rarely accompanied by thunder and lightning, and may consequently be termed gentle rains, the word applying both to the quantity of the rain and to the force with which it descends.

South of San Quentin begins a short transition zone towards the tropical arid zone. As the winter rains become scarcer the tropical rains of the next zone become more frequent during the summer months—June to November. They do not occur, however, yearly, but at intervals of from one to three or more years. But as we near the Cape Region these tropical rains become more frequent, and from the vicinity of Todos Santos south of Magdalena Bay they may be considered as of yearly occurrence.

The "tropical arid zone" may be said to be fully characterized at the northern boundary of the Cape Region, though even here the influence of the northern winters makes itself felt at rare intervals. This influence manifests itself in the shape of occasional fogs, and in gentle rains, during December and January. In the vicinity of San José del Cabo such rains and fogs occur at intervals of one to several years. As a rule, the tropical arid region of the Pacific coast is characterized by rainy summers, the rain beginning in June and lasting to November. But even in this zone the change is gradual and irregular. While north of the Cabo San Lucas the rains on the Gulf coast begin frequently as early as the middle of June, they may in the vicinity of San José del Cabo seldom be looked for before September. However, as we enter the Mexican mainland on the Pacific, the summer rains become more frequent, as well as heavier. From Mazatlan southwards the months of June to October can always be counted on as rainy, though even here the rains are irregular and capricious. As we go south, in this zone, the rainfall increases in quantity as the season lengthens, but this increase in quantity and in time is much less marked than in the extra-tropical arid zone. This feature of homogeneity in the distribution of the rainfall in this zone is undoubtedly due to the physico-geographical features of the coast and the land back of it. We must remember that, while the rains of the extra-tropical arid zone originate in the Alaskan region, those of the tropical arid zone come from the evaporations and *lows* in the Gulf of Mexico. This solitary influence of the Gulf of Mexico extends as far as the southern boundary of the Gulf of Tehuantepec or the isthmus of the same name. South of this point precipitation is influenced by two sources of *lows*—one in the Gulf of Mexico, the other in the Caribbean Sea.

To this difference in the precipitation of rain, both as regards quantity and time, along the Pacific coast, is due the characteristic

appearance of the coast-line. Along the coast of California the forests rarely descend to the shore-line. This is especially the case south of Point Conception. The shore hills are here mostly bare or sparsely wooded with oaks; while upon the higher ridges may be seen pine and other conifers. During the rainless months—May–November—this coast presents to the traveller an uninterrupted waste of yellow rounded hills, only here and there dotted with darker live-oaks. As we approach the boundaries of Baja California even this remnant of evergreen trees and shrubs becomes scarcer, until at last south of San Diego they entirely cease. Along the coast of Baja California we look in vain for any traces of shore forests. Seen from the ocean the coast appears extremely barren, and only here and there do we find at the mouths of cañons clumps of cottonwoods, or mesquite trees. An exception to this so very barren aspect of the shore-line is seen on the island of Cedros, where the higher ridges near the shore are covered with pines.

As we enter the tropical arid region the shore aspect becomes less forbidding. At San José del Cabo a fringe of cocoa palms marks the shore; while during the rainy seasons the hills near and far are covered with a dense verdure, resulting from innumerable species of acacia-like shrubs and trees.

South of Mazatlan we meet, for the first time, with denser forests along the ocean shore. The part nearest the water's edge is always occupied by a thin belt of palms, principally cocoa and cocoayol palms. Behind this belt we find here and there, especially where the soil is of an alluvial nature, more or less broad belts of tropical forest of evergreen dicotyledonous trees. But in all this Mexican region the hills immediately above the coast-line are comparatively bare of evergreens, and principally covered with shrubs and small trees with deciduous leaves.

From the northern part almost of Baja California to the vicinity of San Benito, near the Guatemala boundary, the traveller beholds a backbone ridge—a sierra—with sharp peaks of generally fantastic shapes. These are bare of trees, but prominent on account of their rocky nature, which the seasonal rains have never been able to cover with an evergreen vegetation. This is the general aspect of the country as far down as the Isthmus of Tehuantepec. In the vicinity of the isthmus the interior sierra has dwindled to low rounded hills, while the immediate coast-line has preserved its barren aspect, due to irregular and not overabundant rains. But at San Benito we suddenly perceive a great change. The barren rocks, formerly so common and so monotonous, disappear entirely, giving place to an

evergreen tropical vegetation of shrubs and forests. The continuous belt of cocoa palms along the shore gives place to mangrove swamp-plants, of low height, the palms retreating to the higher inland hills. The fantastic peaks of an interior sierra have been replaced by an immense cordillera so densely covered with vegetation that not a bare rock or stone can be seen anywhere. From this general cordillera there rises, at certain measured intervals, a succession of volcanic cones of surpassing beauty and grandeur.

Climatic Conditions of Guatemala.

Guatemala is situated between 13° 42′ and 17° 48′ lat. N., and 88° 10′ and 92° 30′ lon. W. Greenwich. While this situation determines the general climatological conditions of Guatemala, it does neither account for the climatic peculiarities of the country as compared with those of the adjoining countries, nor for the differences in climatic conditions of the various parts of the Republic itself. The main factors which regulate these conditions are the height and extent of the mountain regions. By far the greater part of Guatemala consists of an elevated mountain-complex, which is further subdivided into a complex system of mountain ridges separated by more or less elevated valleys. It is to be regretted that this country, as well as the rest of Central America and Mexico, has never been properly surveyed, and that the existing maps are in many respects incorrect. As regards meteorological records, the case is aggravated by the carelessness of the observers of the few existing stations and the absence of scientific interest with which their observations have been made. The scarcity of the stations is such that it is at present impossible to form any correct idea of the origin and movements of the *lows*, upon which the general rainfall is dependent. The main feature which distinguishes Central America from Mexico is that the former country receives its rainfall from two distinct sources at the same time—*lows* originating both over the Pacific Ocean and over the Caribbean Sea. This insures a much greater and more evenly distributed rainfall to Central America than to Mexico. This is the principal difference between the two countries. The differences depending upon changes in temperature are slighter, as both countries are elevated and, as regards their interior tablelands, often visited by heavy frosts, which in the highest places are of great continuity and often intense. The main climatic factors are, then, the humidity of the air, the temperature and the rainfall, each of which will now be considered more in detail.

Humidity of the Air.

As might be expected in a country situated between two tropical oceans, the humidity of the air in Guatemala is very great. There are, however, considerable differences in different localities. As a rule, it may be said that in the mountain region and in the low coast-belt the humidity of the air approaches a more perfect saturation than in the interior valleys. The northern mountain region is much more humid than the southern, and the Atlantic coast is much more moist than the Pacific. On the Pacific side the saturated air-belt stretches along the whole coast from San Benito, in Mexico, far south towards the equator. In width this moist belt extends from the Pacific shore-line for about thirty to forty miles inland to a line which runs more or less parallel with the shore, following the crest of the volcanic fissure along which are situated the volcanic peaks. On the Atlantic side, as well as on the northern border, this moist belt is broader. The ascent of the land from the coast is on that side more gradual, and the mountains, as a rule, are less elevated. The moist belt-line is on that side more irregular and ends less abruptly than on the Pacific side. Roughly speaking, a line running east and west passing through Huehuetenango, Salamá, and Zacápa divides the extremely moist zone from the one less moist. To the north of this line we have the high mountain-complex, in which all the largest rivers in Guatemala and Mexico have their head-waters; while to the south of that line we meet with interior valleys more or less surrounded by high mountains, and which are characterized by a comparatively low humidity of the air. Going from west to east, this humidity of the air decreases, as is clearly seen if the valleys of Huehuetenango, Quiché, and Salamá are compared. This is due to the fact that the valley of the Rio Grande or Motagua, which runs from west to east, is much lower than any of the other inland valleys, the moisture thus having been precipitated on the surrounding high mountains before it reaches the basin below. The decrease of moisture is so great that the basin of Salamá and a great part of the Motagua basin partake to a considerable extent of the nature of a desert region in which crops require to be irrigated by artificial means.

The interior tablelands, extending from the coast cordillera on the Pacific side to the high mountain complex mentioned above, enjoy a comparatively moist air both in winter and summer, the moisture, however, being less than in the belt surrounding them.

But even within a territory in which we might expect an even distribution there are found great differences, difficult to account

for. These will be further considered in connection with the botanical zones; here we will only state that everywhere the humidity of the air is much greater in the forests than in the open country. This may be readily observed in places where the formerly impenetrable forests have been cut down in order to leave room for plantations. But even in places where no such destruction has taken place we meet with vast areas in which the humidity of the air falls so low as to become insufficient for the wellbeing of most so-called tropical plants. This is especially marked in the regions of the savannas, in the highest part of the cordillera and the northern sierra, and in the valleys of Salamá. According to statistics furnished by the Laboratorio Químico Central in Guatemala, the greatest saturation takes place just before sunrise. In Guatemala City the average humidity at that hour throughout the year is 89%; while at noon it is 69%, and at 9 P.M. 87%. In Alta Verapaz, at nearly the same altitude (4,883 ft.), these numbers would be respectively 95%, 72%, and 86%.

Rainfall.

The abundance of the rainfall in Guatemala is, as has already been stated, due to *lows* on either side of the continent. In the zone situated north of the Huehuetenango and Zacápa line the precipitation takes place principally during northeast winds; while south of this line the rains are generally precipitated during southern winds. It is thus evident that we have here to deal with two systems of *lows*—one originating in the Pacific and the other in the gulfs of the Atlantic Ocean.

We can, in Guatemala, distinguish between three more or less distinct zones of precipitation; but, as a rule, it may be said that the rainy season lasts between the months April and November, the months from December to March being those in which the least rains fall. The first of these zones of precipitation is situated north and east of the Huehuetenango-Zacápa line, including the high northern sierra complex, with the Cobán region as well as the Atlantic slope. In this zone the rains are less confined within certain seasons. The rainiest months are those between April and November, but rain may be, and generally is, precipitated during every month in the year. Especially is this the case in the highest part of the sierra region and along its northern slopes—that is, the headwater-zone of the large rivers Usumacinta and Chiápas, Rio Polochíc, and Cáhabón. In the zone of the Rio Chiápas daily fogs are the rule. These fogs degenerate into rain, which, while

sometimes gentle, generally finishes in tremendous downpours. The rain precipitation in this zone has never been accurately measured, but it is safe to say that it is by far the greatest in Guatemala, and that it reaches 6,000 millimetres or more (240 in.). In the eastern part of this large northern rainbelt the rainfall averages between 3,000 to 4,000 millimetres (120–160 inches), being less in the valleys of Rio Cáhabón than in the surrounding mountains.

The second zone of precipitation is situated south of the line Huehuetenango-Zacápa, and extends to the volcanic cordillera, which runs parallel with the Pacific coast. It occupies the whole of the large interior tableland of Guatemala, the principal part of the district being the válleys tributary to the Rio Grande or the Motagua. Of this zone the northeastern part is the driest, this part including the valley of Salamá, a tributary of the Usumacinta. Here the moisture and rainfall are especially scant at any time of the year, and a month or two may pass in the middle of the rainy season without any precipitation. The explanation is that the moisture in the air, carried to these interior valleys by northern winds, has already been precipitated on the northern slope of the surrounding sierra. The change from the dry plains around Salamá to the moist ones of Cobán is most marked and interesting. Ascending from Salamá the high mountain crest which separates the two places, the traveller has to pass for ten leagues over comparatively barren hills, on which not even drinking water is found during the dry season. But upon arriving across the range he finds himself, without any warning, in a paradise of freshness, where every acre of the ground is watered by springs, and where the soil is clothed with eternal verdure.

The valley of the Rio Grande is especially dry and inhospitable to vegetation, resembling, during the dry season of the year, the barren hills of the Mexican Pacific shore. As we proceed towards Guatemala City the rainfall increases, and the aspect of the vegetation is less barren. It is to be remarked that in all this interior zone the mountains are more favoured with precipitation than the valleys. A few hundred or a thousand feet may make considerable difference in the rainfall of the respective localities. The amount of rainfall in this zone varies considerably. In Guatemala City the precipitation averages 1,500 millimetres (60 in.). In Salamá it averages 600 millimetres (24 in.); in Quezaltenango, on the eastern border of the zone, it is somewhat more than in Salamá, or about 700 millimetres (28 in.). In this interior zone the dry season is well and clearly separated from the rainy one. The rains seldom

begin in earnest before May, and they generally finish in October. The months from October to April may be counted as dry, though exceptions may occur. The precipitations in this zone are, however, far from continuous or of daily occurrence. In the beginning of the rainy season we may expect a shower every afternoon for some days in succession; then several days may pass in which there is no rain. A more prolonged spell of continuous dry weather is regularly experienced in the middle of August, when, according to expectation, no rain falls for two weeks. The year of my first visit this dry period occupied fifteen days; while during my recent journey no rain fell for five weeks.

In this zone the first rains are expected at the end of April or the beginning of May. The popular idea is that it always rains in the City of Guatemala on the 4th of May, but, like all other popular beliefs, this one is not to be relied upon; statistics show that rains commence in April as often as in May. The first showers are generally, if not always, accompanied by thunder and lightning. For weeks previous the sky is generally overcast with apparent thunderclouds during the middle of the day, though no precipitation results. Later on, the mornings are clear and bright; but at noon clouds are seen gathering in the south, and between 1 P.M. and 2 P.M. a thundershower may be expected.

This is repeated, on an average, about fifteen times during each of the months June, July and September, with a perceptible falling off in August. In October and November the thundershowers are rare, the rains then being of a drizzly nature, like those on the coast of California. At the end of the rainy season the sky does not clear at once, but remains cloudy for days, or even for several weeks, after precipitation has ceased. But instead of clouding up only in the middle of the day, we find that at this period already the mornings are cloudy, while the middle of the day is clear.

In this zone, as well as in the two other zones, the precipitation takes place during the height of the rainy season twice a day. As stated, the first showers commence rather regularly between 1 P.M. and 2 P.M., lasting up to one or two hours, or less. In the evening, between 7 P.M. and 9 P.M., another rain may be expected of from one to several hours' duration. In this zone, as well as in the two other zones, rain in the morning and forenoon is of extremely rare occurrence, and the traveller can nearly always count upon fair weather from 4 A.M. to 12 noon in any part of Guatemala.

The third zone of precipitation extends from the Gulf of Tehuantepec along the coast of Guatemala past its southern boundaries.

This zone is characterized by a much greater amount of rainfall than the interior zone, but by a lesser one than the northern zone. In this coast region we may also distinguish two seasons—one dry and one wet. The dry season occupies the months of December to April, the wet one the remainder of the year. Nearly the whole of the precipitation comes in the nature of thundershowers, gentle rains being of rare occurrence. The rain always comes with southern winds, and with accumulation of clouds along the crest of the coast cordillera. It is heavier along the slopes of the cordillera than farther down along the coast. The quantity may be considered as somewhere near 4,000 millimetres (160 in.). The rainy season begins about the same time as in the interior, or in March to May, but it lasts about a month longer than in the interior. The rains are generally accompanied by heavy winds, which, during the height of the season, are of great force, but of short duration.

There are two periods of precipitation daily—one between 1 P.M. and 8 P.M., the other from 8 P.M. to 9 P.M. A third period is often in the morning hours, between 2 A.M. and 4 A.M. Between these periods of daily precipitation the sky clears along the lowlands, though along the crest of the cordillera the volcanic peaks are nearly always obscured, except from 6 A.M. to 8 A.M., when they may be clearly seen. The rainfall diminishes towards the southeast to such an extent that there is probably a difference of about 1,000 millimetres (40 in.) between that of the boundary line of Mexico and that of Salvador, the main cause being, probably, the diminished height of the cordillera towards the southeast. The greater rainfall in the region known as the Costa Cuca may also be due to the fact that this part receives also precipitation from *lows* originating in the Gulf of Mexico, but rarely extending south of the point of San José.

Temperature.

There are two maxima and two minima annually, according to the position of the sun. The maxima occur in April–May and August, and the minima in July and December–January. The maximum in July is tempered by the cloudy skies and the rainy spells of the winter months, while the minimum in January is moderated by the dry air and the constant sunshine during that time. The daily fluctuation of temperature shows that the lowest point is reached at sunrise, while the highest is registered at about 2 P.M.

The mean temperature in the City of Guatemala is, indoors, 74° Fahr., while out-of-doors it is 66°. In the sun it seldom reaches 86°. From sporadic observations made by travellers and a few per-

manent settlers it is supposed that the mean temperature of Salamá is 74°; that of Quezaltenango, 58°; that of Port Barrios, 78°.

The frost-line of the Pacific slope coincides with a line passing along the crest of the cordillera at an altitude of about 4,000 feet. This is also the altitude of the base-line upon which rest the pyramidal cones of the volcanoes and the passes situated between them. On the coast side of these passes and below them frosts are unknown, but slightly interior to the passes frosts occur at rare intervals, increasing in frequency with the altitude. The frost-line marks the limit for the cultivation of the coffee tree, and, to some extent, for the profitable production of sugar-cane. But it is interesting to note that the best coffee, as well as the best sugar, is produced close to the frost-line, such coffee and sugar being more highly flavoured than that grown in the warmer lowlands.

The practical experience as regards the wellbeing of man in Guatemala is that, except for the narrow coast-belt, the temperature is comfortable and agreeable, and, as regards sensation, almost ideal, both winter and summer.

Electric Storms and Circular Lightnings.

Thunderstorms are characteristic of all parts of Guatemala, but especially so of the Pacific coast along the cordillera and in the highlands of Alta Verapaz. In the high mountainous complex of the Departments of Huehuetenango and Quiché they are comparatively rare, though along the interior valleys they are more frequent. During a journey from Chaculá, on the Mexican border, to Aguacatán, I was told everywhere that thunderstorms were rare. During my stay there we had no thunderstorms, though heavy rains were of daily occurrence. During the months of November to January electrical storms are rare, though they do occur. During this time the sky is generally clear during the early part of the day, and magnificent distant views may be had, which is not the case during the months from April to October.

The intensity and frequence of the lightning flashes during the height of the rainy season are something extraordinary. During a single evening, while travelling from San Juan Sacatepeque to the City of Guatemala, I counted more than one thousand lightnings from a single group of clouds in the direction of Tecuamburro, which locality seemed especially favourable to these phenomena, repeated almost every day for nearly a month (September).

Almost every traveller in tropical Central America has described what is known as "circular lightning." These lightnings occur

generally at the end of the rainy season, and are more frequent on the coast than in the interior. It has been supposed that they are due to a certain quality of electricity, differing in intensity from the ordinary. The observer sees no rays, but simply a disk-like flash in a cloud, with a perfect absence of electric streamers. During my stay in Guatemala I had frequent opportunity to observe this interesting phenomenon, and I think the explanation is not a difficult one. I am satisfied that there is no difference in quality nor in quantity in the electricity of the two kinds of lightning, but that the cause is the character of the clouds. While in countries outside of the tropics thunderclouds occupy, as a rule, a single stratum in the air, in Guatemala and other parts of Central America it is not unusual to find two, or even three, distinct strata of cumuli, one above the other. When electricity is discharged from clouds arranged in a single stratum, the discharge takes place either between the clouds and the earth or between two clouds approaching each other. The same may, of course, be the case when we have two strata of cumuli, one above the other. But sometimes this is not the case, and, when three strata of cumuli are superposed, regular electric streamers are rarely observed. Instead of discharging to the earth the discharge takes place between the respective strata exactly in the same manner as usual; but the fact that we then frequently see the discharges in the direction of their longitudinal axis prevents us from observing the streamers. For instance, the discharge takes place between two clouds, one above the other, the two being shielded from our view by a third lower one. We then see, not lightning streamers, but simply a single flash, which is reflected by the cloud-banks immediately surrounding it. During my night trip just referred to I had ample opportunity to observe this phenomenon, and out of the one thousand or more flashes observed, at least six hundred belonged to the circular class. Whenever there was a rift in the cloud-banks and the discharge was oblique to the axis of view the streamers were distinctly visible. Many times there were observed as many as three distinct electric discharges at the same moment. The central lightning, being hidden by a cloud, was then often circular, while the side flashes were seen to be streamers of the most pronounced nature. These, my first observations, were confirmed by many others, and I satisfied myself that circular lightning is simply an electric discharge between two or more small cumuli superposed on each other, the point of observation always being in the direction of the axis of discharge. Thus, what will appear

as a circular lightning to an observer placed in the extended axis of discharge, will appear as stream lightning to any one who sees the same discharge from a point of view outside of the prolongation of the above axis, and when both clouds are distinctly in view. Such circular lightnings have not been known to strike the earth, as the discharge is intercepted by the lower stratum of cumuli. Whenever the lower stratum of cumuli is continuous, all the flashes appear as circular or disk lightnings, but where breaks occur in the low stratum the lateral streamers become visible as such.

Vegetation Zones.

With a few exceptions, all the soil in Guatemala is covered by vegetation. In some localities this vegetation is scant and of an arid aspect, but, as a rule, it is of a tropically luxuriant nature. As in most countries which rise abruptly from the ocean, and which, besides, are characterized by immense interior highlands, zones of vegetation are well defined and highly characteristic. The student of geographical and physical botany has in Guatemala a wide and interesting field, as in few countries are there to be found such a variety of extensive vegetable zones. As elsewhere, these zones are determined by temperature, humidity, altitude, and exposure to winds. While these zones are scientifically very interesting, they are also of great economical importance, and the horticulturist must take them into consideration if he hopes to succeed in making profitable investment. Each one of these zones of vegetation is also favourable or unsuitable to certain economic plants, both native and imported ones, and the prosperity of the country is thus dependent upon a proper understanding of the nature and extent of the different zones.

The general opinion of those who are not acquainted with the tropics of Central America is that the country is intensely hot and moist, and more or less unfit for one born in northern or more temperate latitudes. As regards Guatemala this opinion is especially erroneous. With the exception of a comparatively narrow strip along the two oceans the Guatemala climate is temperate, and tropical only as regards absence of extremes of temperature. Considering only the larger and more strikingly distinct zones, we may limit them to two—the great littoral region along the shore of the Atlantic and the Pacific oceans and the great interior highlands. If we count in the almost unpopulated or rather uncultivated region occupied by the territory or Department of Petén—which, of course, is not littoral—the former region occupies about one-half of the

whole Republic. This half may be considered as warm and moist, with no great distinction between a dry and a rainy season. The other region, comprising the tablelands, is characterized as dryer and more temperate, with a distinct division into a dry and moist season. But upon a closer examination we find that this general section is not strictly correct, though it gives a rough general idea of the nature of the country. As the nature of the vegetation zones depends upon three or four different factors, it becomes evident that, according to the various combinations of these factors, the result must be several distinct zones of vegetation. These we will now consider somewhat more in detail.

The Littoral Saline Zone.

This zone occupies the fringe of the Pacific shore and, to some extent, that of the Atlantic side, wherever the shore is low and covered with larger and smaller *esteros* or lagunes with salt or brackish water. Another name for this region is "mangrove swamps," though the vegetation is not alone confined to mangrove plants. This zone is very narrow, seldom more than a few miles in extent, and of varying length according to the height of the land above the high-water mark. Where the swamps are broken through by elevated or rocky projections the mangroves are replaced by tropically dense forests similar to those of the next zone. Such, for instance, is the case at the southern extremity of Guatemala near the boundary line of Salvador. The vegetation of the mangrove zone consists of evergreen shrubs or low trees, rarely over twenty feet in height. These thickets are always so dense that they may be considered impenetrable, except where canoes pass along the open channels of the *esteros*. This zone is unsuited to cultivation, except in places where the land rises above the saline swamps. In such localities cocoa palms and other tropical plants may be cultivated to a limited extent. This region is feared on account of the fevers; but the knowledge that the cause lies with the mosquitoes does not seem to have reached those who should be most interested in knowing it.

The Humid and Warm Arboreal Zone.

Wherever the saline esteros give place to higher lands we meet with impenetrable forests of majestic tropical trees. In Guatemala this zone occupies the littoral of the Pacific, the littoral of the Atlantic, the Bay of Honduras, the northern slope of the northern sierra complex occupying the Departments of Huehuetenango and

Alta Verapaz, and also the larger part of the immense territory of Petén. These originally impenetrable forests extend in some places from the waters of the ocean to an altitude of over 10,000 feet on the slope of the Pacific coast cordillera. On the northern slope of the northern sierra these forests gradually merge into those of the next zone; but I incline to think that they do not reach as high an altitude as on the Pacific side. The forests in this zone are composed of dicotyledonous trees of tropical genera and species in great variety. The trees are evergreens, and many are of great height. The most prominent trees of this zone are the *ceiba*, in many species, and the gigantic figtrees or *higuerones*. The ceiba must be considered as the largest tree in Central America, not perhaps as regards height, but certainly when bulk is considered. The forests in which these trees grow are characterized by their density, due not alone to the undergrowth of smaller plants and the close proximity of the large trees, but principally to the impenetrable growth of parasitic plants of various nature. With a few exceptions, every tree is a botanical garden in itself, covered with climbing aroids, with morning-glories (*Ipomea*), with ferns and orchids. The exception to this is found in a very few tall and slender trees which shed their bark annually. On such trees the climbers do not get a hold, but are shed with the bark of the tree. The most remarkable tree of this nature is called the *Tumbador*, with leaves like a papilionaceous plant, to which family it probably belongs. The stem of the tree is slender, without branches except at the top, and the bark is smooth and white—a striking exception among trees which are covered from top to root with a dense network of climbers, often to such an extent that only the very crown of the tree is visible.

The form of the trees in this zone is generally uniform. A tall, slender and erect trunk, free from branches; at the top of the trunk a large, broad umbrella-shaped crown, with powerful but elegant branches spreading evenly in all directions. The trees are commonly furnished with buttresses, which support the trunk and prevent it from toppling over or bending. The tall and unbranched trunk gives the minimum lodging to parasites, while the umbrella-shaped crown catches as much sun and air as possible. If trees of a different form were introduced into these forests and allowed to care for themselves they would soon succumb. The parasitic plants would soon break the branches of a tree that spread out close to the soil, while trees with narrow and upright crowns would not receive the necessary sun and air.

These forests are dependent upon moisture and a rich soil, and, to a lesser extent, upon temperature. While we find different species of trees composing the forests of the lower and upper parts of this zone, the general nature and aspect of the woods from the water-level to the crests of the cordillera are very much the same. Except where the soil differs or where the axe has interfered, the same forest covers the lower level lands and the slopes of the towering volcanoes, up to a certain height, where heavy frosts interfere with the growth of tropical plants.

Strictly speaking, however, this zone is not absolutely homogeneous. Wherever the soil is either poor, too sandy, or underlaid by hardpan, the forests give room to more open places, covered, not with tall trees, but with large and dense shrubs, in which the tall and slender bamboos take a prominent place. On the other hand, along the Pacific coast of Guatemala, we observe large dikes of lava rising in the shape of curiously-formed hills above the general level of the slope. On such *peñascos* the vegetation is less dense, but not the less interesting. However, as these localities are dependent only upon the nature of the soil for their distinctive vegetation, we do not classify them as distinct zones.

The magnificent forests are rapidly disappearing. At the time of my first visit to Guatemala the slopes of the volcanoes facing the Pacific were yet covered with them. In vain did I now hunt for these marvellous productions of a tropical nature in places where formerly they had attracted my attention. They had been cut and burnt, and sugar plantations or coffee *fincas* have taken their place, or herds of cattle pasture upon planted fields of *zacate* or forage. In twenty years more the Pacific coast will have no more primeval forests to show. The best preserved of the few remaining forests are found along the new coast railroad from Aguna to Mazatenango.

The Temperate Arboreal Zone.

This zone occupies the interior of Guatemala from the crest of the Pacific coast cordillera to the humid region of the north and east. As soon as the traveller has passed the culminating backbone of the cordillera he finds himself in a region less humid and more temperate than that of the coast. The luxuriant vegetation of the volcanic slopes or of the dense forests of the Alta Verapaz has given place to more open forests of oak and pine. To a large extent, these forests have long ago been cut down and fields of maize and beans have taken their place. Originally the whole

country was undoubtedly covered with a continuous belt of these trees, the *barrancas* or the topmost ridges being the only places characterized by a more luxuriant growth. The aspect of this zone is that of a forest region of the temperate parts of the United States, especially the foothills of California. We meet with four or five different kinds of oak and one or two of pine. The oaks are generally small or of medium growth, a large tree being an exception. The small size of the oaks seems principally due to the shallowness of the soil, as in places where the soil is deep and rich the same varieties attain to much larger dimensions. Gigantic oaks like those of the North American forests are, however, nowhere to be found. As far as I know, all of the oaks are of the evergreen kind. The pines are generally small and branched, and only one species seems suitable for lumber. These straight and tall pines are principally found in the northern cordillera in places where the temperate and the humid zones interlace, as will be described further on. The undergrowth in this zone is not as dense as in the lower zone of the cordillera. The trees are to some extent covered with climbing morning-glories, while on the horizontal branches live orchids in great variety, some of the handsomest species being found on the oaks of this zone. In open places and along the edge of the forests the ground is covered by a large variety of magnificent *compositæ*, among which the sunflowers are especially noteworthy and beautiful. Thus on the slopes connecting the humid warm zone with the present one we find extensive fields of brilliant flowers, principally gold and white. Nothing is more charming than the aspect of the lands between the volcanic peaks, which at the end of the rainy season present a wealth of colour such as is seen in the meadows of the high north. The difference is, however, that while in the north the plants are of low growth, in the tropics they are tall and bushy and the flowers large and luxuriant. In this floral display the morning-glories take a prominent place. Every few miles we meet with different species, characterized by distinct colouring, shape, and size. Some are gigantic, while others are lilliputian in size. Among the most charming fields of this nature were those on the slopes of the Volcan de Agua and the western sides of the lakes of Amatitlan and Atitlan. Even in the high sierra of the Department of Huehuetenango immense fields of compositæ charm the traveller with their rich colours and their delicate perfume.

Zonal Wedges in the High Sierras.

It is most natural to suppose that the two zones characteristic of the high sierra should follow each other with some regularity, as do the zones in more temperate regions outside of the tropics. But such is not the case; and this fact was one of those which appeared to me as of the greatest interest. The warm moist arboreal zone is everywhere in Guatemala known as the *Montaña.* It is characterized principally, while remaining in its primeval state of nature, by impenetrable evergreen forests of broad-leaved trees, bound together by dense thickets of climbers and parasitic plants, all indicating the immense fertility of tropical nature. The temperate arboreal zone is characterized by the scarcity of evergreen climbers, by the absence of an impenetrable undergrowth, by the presence of pines and other plants which indicate the more barren nature of a less luxuriant climate. In most countries such arboreal zones occupy different altitudes, the less luxuriant one being situated above the other. But in Guatemala this is not always the case. For instance, along the north and western slope of the high sierra, from Nenton towards the Mexican boundary and the western arm of the Rio Lacandon, we find that these two zones interlace with each other, occupying the same altitude side by side. Thus, for instance, in ascending from Chaculá (5,500 feet) to the higher altitudes of San Mateo Ixtatán, we can have our choice by passing through one or the other of these zones. Through the humid zone it is only with the greatest difficulty that we can make our way, every step being contested by *montaña.* But by following another trail, perhaps a mile to one side or the other, we may pass through comparatively dry pine forests, in which we look in vain for anything to remind us that we are in a tropical country, and by turning a little to the left or to the right, we can move from one zone of vegetation to the other. The main cause of this sudden change seems to be the drift of the clouds. If from a lower standpoint we observe the hills and the general movement of the clouds during the dry season, we find that day after day the clouds seek the same mountain slopes and tops. We may be absolutely certain that the slopes covered with cloud consist of *montaña* lands, while those which remain uncovered are clothed with pine forests. In this manner the two zones are often wedged into each other with great irregularity. The soil in the two zones is different. In the humid zone it is deep and black, and even during the dry season so wet that the trails are impassable. In the pine zone the soil is dry, shallow, and of chocolate colour, the very opposite to the former. This indicates that similar condi-

tions have existed from time immemorial—from the beginning, perhaps, of the Tertiary period. The most plausible explanation, if I may venture on one, of this phenomenon is that, owing to the configuration of the mountains and their situation between an upper colder zone and a lower warmer one, a certain regularity in the air currents has been established in such a manner that the cold currents always follow the same routes. Upon reaching the cold currents the moisture in the air condenses in the form of clouds, which, again, keep the vegetation green and luxuriant all the year round. As to the cause of these currents or zones of colder air, the configuration of the country and its mountain slopes has not given me any satisfactory clue.

The rock formation—of limestone bed-rock—is similar throughout, and there is no difference in the altitude of the two zones.

The Humid and Cold Arboreal Zone.

This zone occupies the high valleys of the northern sierra, as well as some of the upper slopes of the volcanoes. Its extent is not well defined, and it is less known than any of the other zones. The best samples of these magnificent forests are seen in the Departments of Huehuetenango and Alta Verapaz. Here we find them in the valleys connecting the high tablelands with the forests of the humid warm zone. In passing through Guatemala, from the capital northwards to the boundary of Mexico, we do not meet with any representatives of this zone until we reach the crest of the sierra north of Chiantla. Here we find that the oaks and pines of the tablelands of the last zone have given place to gigantic and magnificent cedars, vines, and cypress trees, with erect stems and large umbrella-shaped crowns. Nowhere have I seen anything in nature that has so inspired me with admiration and astonishment. No words can describe the beauty and magnificence of the trees. They stand close together, and, with a thick undergrowth of oaks and other semi-tropical trees, form masses of verdure, impenetrable alike to wind, and sun, and man. The clouds hang over these forests throughout the year, and the condensed fogs drip to the soil as an almost constant rain—at least during certain hours of the day. The individual trees are of majestic size and marvellous beauty, forming an assemblage perhaps not equalled elsewhere. The undergrowth consists of evergreen shrubs and smaller trees, especially of the family of *Vaccineæ*. Even the tropical forests of the coast-belt do not impress one as do these giants of the high sierra. On the higher rocky places the cedars are replaced by junipers hardly inferior in size and fully as beautiful in

form. The greatest altitude of this zone is about 12,000 feet, above which no trees are found. But as in this part of Guatemala few peaks reach any higher elevation, it is extremely rare to find any place not covered by dense forest. In the upper parts of this zone the traveller may expect to meet with heavy thundershowers and hailstorms during any time of the year, but especially during the months of June to September, and then principally in the early afternoon. During the rainy season these forests are rarely clear from fog or clouds more than a few hours in the forenoon. Already long before midday they cover themselves with clouds; while in the afternoon they are dripping with rain. The forests grow densely in the protected but precipitous valleys, the lower limit of which is about 7,000 to 8,000 feet in some localities; while perhaps only a few hundred yards away the lower limit is several thousand feet higher, the difference depending upon the currents of wind and the exposure. In these forests orchids are rare, and the density is not caused by parasites, but rather by the interlacing of trunks and branches. Happily for the preservation of these marvellous growths, few roads exist in these places, making it as yet unprofitable to export or utilize the lumber, but near the cultivated districts the trees have suffered much by fires started by the Indians. These forest lands are very fertile when once cleared, and in order to utilize them the natives cut some of the trees and then fire the brush. In this manner a great part has been destroyed. The worst consequence is that the land thus gained is not cultivated more than two years in succession. Already in the second year a new growth of different plants springs up, which the natives find too difficult to destroy. It is easier to fell new trees and to burn the ground over than to grub up the new weeds in the *milpas* (maize plantations). But where thus the old forests have been destroyed no new one of the same nature takes the place. The new growth consists of different trees, like those found in the temperate zone—oaks and low-growing pines. The cedars and cypresses do not return.

The Dry and Warm Zone.

This zone, which is one of the best characterized, occupies certain valleys in the central part of Guatemala. These valleys are all surrounded by high mountains, on the slopes of which the humidity of the air has been precipitated before it reaches the valleys during the rainy season. Similarly, during the dry season the moist northern and eastern winds are prevented by the high ridges of the sierra from modifying the climate of these valleys. The deep river basins of the Rio Grande and the Motagua belong

to this zone, and so do the depressed plains around Salamá and Cáhabón in Alta Verapaz. The traveller who descends into either of these valleys from the surrounding high and moist ridges finds himself suddenly in a territory of different temperature and vegetation. The cool air of the ridges has given place to intensely hot and dry calms, in which even the shadows of the *barrancas* give little or no relief. The luxuriant vegetation of the ridges has been superseded by deciduous trees of small growth and dense thickets or *chaparrales* of thorny bushes, while the open places are characterized by desert types, such as cactus, yucca, agave, bromelias, and other plants of the arid region. In this zone no crops can be profitably grown without irrigation, except corn, which, however, is raised to a very limited extent. On account of their high temperature these valleys are classed as the *tierra caliente.* Here flourish the cocoa palm, the sugar-cane, and other tropical plants which cannot support the low temperature of the temperate zone. The arid nature of this zone is due to several circumstances combined. The first is the scanty rainfall. Another cause is that a layer of hard clay, sometimes even of a rocky nature, lies close below the topsoil and prevents the absorption of the rain. This is the case in the valley of the Salamá and in that of Cáhabón. Another reason is the comparatively low elevation of the valleys, that of Salamá being less than 3,000 feet. This depression accounts for the greater heat of these valleys. In the valley of Salamá we find the surface often barren, only here and there covered with low, globular cacti, between which are smaller herbs and grasses, not dense enough to hide the soil. On the slopes of the low hills around the valley we find among the low shrubs, known as *chaparral*, dwarf fan-palms or palmetto. For fences in this region the cultivator plants tall, columnar cacti, which soon after planting become impenetrable by cattle. In slightly elevated and stony places we meet with different varieties of cacti, some of which are of considerable height and of columnar and branching form, while others partake of the nature of broad-leaved opuntias. A characteristic tree planted along the roadsides is the *ojote*, its branches being peculiarly twisted and noded and covered with a shiny yellowish-brown bark. But this so apparently inhospitable zone presents during the dry months of the year a floral display entirely unexpected. At that time the chaparral bushes are covered with multicoloured flowers in great variety, and it is evident that in this region the botanist will find a rich harvest of as yet unknown species. As pasture grounds for cattle these plains or hillsides are poor and only suitable during the rainy season. During the dry season the cattle must be driven

to the mountains. With irrigation, however, this territory becomes immensely fertile, as may be seen in the many fine plantations of sugar-cane in the vicinity of Salamá.

The Savannas.

These zones, which are nowhere continuous, occupy a very limited territory in the high sierra and on the upper part of the volcanoes of the cordillera. The cause of the limitation of these zones is not known with certainty, but it appears that the influencing factors are intense cold and heavy, perhaps at times drying winds. In this zone we find few or no trees, but often an abundance of bunch-grass. One of the most interesting localities of this zone is found above San Francisco el Alto on the road to Momostenango from Totonicapán. The hills are here covered with tall bunch-grass, while trees are entirely absent. Other somewhat similar savannas are found in the sierra of Huehuetenango and above Totonicapán on the road to Guatemala. In the Huehuetenango sierra the grassy plains are broken here and there by rocky ridges with low pines and numerous thickets of agave. While the soil in the pine lands and in the arboreal zone generally surrounding the savannas is of reddish clay, the savannas themselves consist of an intensely black, loose, and very fertile soil, utilized in places for the cultivation of potatoes and corn. It has already been stated that above the limits of the arboreal zone on the volcanic peaks we find a thousand-foot high zone. Besides the wide belt characterized by bunch-grass and the absence of trees, we find among the rocks and in the shelter of the cañons a fine growth of small tree-ferns in the loose soil, above a stratum which is solidly frozen during a large part of the year. The upper limit of the arboreal zone and the beginning of the savannas lies slightly above 4,000 metres (accord-to Ed. Rockstroh).

The Barren Zones.

The only barren zones in Guatemala are the very summits of some of the volcanoes, where the ejected sand and ashes have formed steep cones, on which no vegetation can get a foothold. Such barren cones are found on the volcanoes Pacaya, Fuego, Tacaná, and Cerro Quemado. On the latter there is no sand or ashes, the barren region consisting of ejected lava or andesite rocks. Outside of these few places every inch of land in Guatemala is covered with vegetation of some kind, and generally by one of great luxuriance.

THE CLIMATE OF THE PHILIPPINES.*

BY

WALTER S. TOWER.

The Philippine Islands lie about along the line connecting Borneo and Formosa, between Lat. 4° 45′ and 20° 3′ N. and Long. 116° 4′ and 126° 34′ E. The extension from north to south corresponds to the distance between Milwaukee and New Orleans. The number of the islands is not definitely known, but it has been estimated as high as 1,400. Their area is calculated as nearly equal to that of New England and New York State combined.

Supan, in his division of the world into climatic provinces, places the Philippines in the "Polynesian tropical" province, which is described as a "tropical climate ameliorated by the ocean, so that mild summer weather prevails throughout the year. On the loftier islands rain is abundant and has a tropical periodicity." In a less detailed classification the Philippines are included in the so-called "hot belt"—a temperature zone bounded by the mean annual isotherms of 68° F. The mean annual heat equator crosses the southern limit of Mindanao, one of the most southern islands. Most of the islands south of Luzon are in the area bounded by the mean annual isotherm of 80° F.; Luzon and a few small islands north of it are limited by the isotherms of 75° F. The whole archipelago is within the region of less than 5° of mean annual range of temperature.

The climate may be summarized as follows: High temperature throughout the year; small annual and relatively small diurnal ranges; humid, with excessive rainfalls at times; at certain seasons violent tropical storms, locally called *baguios*.

As the basis of our study of the Philippine climate it is necessary to take the observations made at Manila from 1885 to 1898, since data for other places in the archipelago, except in a few instances, are meagre, or else are entirely lacking.†

* This article formed part of a thesis on *Climate and Man in the Philippines*, written for the course in Climatological Research (Geology 26) given by Professor R. DeC. Ward, in Harvard University.

† Report of Philippine Commission, 1900, Vol. IV., pp. 129–357.

MEAN MONTHLY TEMPERATURES AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
79.°5	80°.2	83°	85°.7	86°.1	84°.8	83°.5	83°.5	83°	83°	81°.7	79°.8	82°.9

Range: 5°.6.

If we compare these figures with those for Aparri, Lat. 18° 25′ N., and La Carlota, Lat. 10° 30′ N., respectively the most northerly and southerly points for which data are at hand, we find that the former has a mean annual temperature of 81°.7; a January mean of 76°.8; a June mean of 85°.9; and a mean annual range of 9°.1. The latter station has a mean annual of 82°.3; a January mean of 80°.6; an April–May mean of 84°.4; and a mean annual range of 3°.8. This comparison brings out the characteristic seasonal uniformity of tropical climate, combined with a sustained high temperature over the whole archipelago; the mean annual temperatures of Aparri and La Carlota differing by but 0°.6, although the two stations are separated by 8° of latitude.

The mean monthly absolute maxima and minima at Manila are given in the following table:

MEAN MONTHLY ABSOLUTE MAXIMA AND MINIMA.

	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
Max....	92°.99	95°.0	97°.1	99°.4	100°.4	96°.1	95°.38	94°.8	94°.8	95°	94°.1	92°.8
Min....	65°.8	66°.4	68°.48	71°.9	75°.1	74°.9	74°.4	74°.4	74°.7	73°.3	70°.7	66°.9

The absolute maximum recorded was 103°.8, in May, 1889; and the absolute minimum 61°.8, in December, 1892. As regards the variation of temperature during the day, the minimum, as would be expected, comes just before sunrise, about 6 A.M.; and the maximum about 2 P.M. These hours vary slightly, from month to month, with the cloudiness. The mean diurnal range of temperature is as follows:

MEAN DIURNAL RANGE OF TEMPERATURE AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
14°.4	16°.1	16°.3	16.7	13°.3	11°.4	9°.5	9°.1	8°.7	10°.6	10°.8	11°.7

The maximum diurnal range comes in the hottest month. The minimum range does not occur in the coldest month, but in September, which has nearly the maximum amount of cloudiness. Thus, the diurnal range is seen to be largely dependent upon the cloudiness; the clear months have large diurnal ranges, and the cloudy months small ranges.

From the fact that our climatic district is surrounded by the ocean on all sides, we should expect to find a high relative humidity. This expectation is borne out by the mean annual relative humidity of 79.4%; the maximum coming in September, the minimum in April. On the basis of observations made at Manila during the years 1856–1898, inclusive, the annual rainfall is 75.5 inches. This amount is distributed through the year as follows:

MEAN MONTHLY RAINFALL AT MANILA (INCHES).

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
1.2	0.4	0.7	1.1	4.2	9.6	14.6	13.9	14.9	7.5	5.1	2.1	75.5

Thus, there is a minimum of rain in the months from January to April, with the absolute minimum in February; and there is a maximum of rain in July, August, and September, with the absolute maximum in the latter month. These months of maximum and minimum rainfalls we should expect to find corresponding with the months having the maximum and minimum number of rainy days. (By a rainy day is meant a day on which a *trace* of rain is observed.) This correspondence is shown in the following table:

MEAN MONTHLY NUMBER OF RAINY DAYS AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
5.1	2.8	3	3.7	9.1	15.6	20.6	20.3	20.2	16	11.17	7.9	135.9

Like all tropical regions, these islands are at times subject to excessive rainfalls. For example, the absolute maximum of rainfall during the period of years mentioned above was 117.3 inches, in 1867. In the same year the absolute maximum of monthly rainfall was recorded in September, 57.86 inches, 13.2 inches of which fell in a single day. The heaviest rainfall ever recorded, in a short time, was in August, 1899, when, under the influence of what is described as an "electric tempest," 1.96 inches of rain fell in 7 minutes.

The distribution of rainfall suggests a classification of the seasons in the Philippines, viz.: a wet season from June to October, and a dry season from November to May. This does not imply that the dry season is absolutely without rain, nor that there is a continual downpour in the rainy season. That this is far from being the case is brought out by a comparison of rainy days and the percentages of total rainfall in the two seasons.

NUMBER OF RAINY DAYS AND PER CENT. OF TOTAL RAINFALL IN THE WET AND DRY SEASONS.

	Rain.		Days of Rain.	
	AMOUNT (INCHES).	PER CENT.	NUMBER.	PER CENT.
Dry Season......	14.95	20	43	31
Wet "	60.5	80	93	69

No month is absolutely without rain except in years of unusual dryness. Hence, although the seven months of the "dry" season have but 1/5 of the total rainfall, it is not absolutely a dry season. On the other hand, the rainy season is so called because the total rainfall is always greater than the amount precipitated in the other seven months. Some writers have used the terms wet and dry season as if they were applicable to the whole archipelago, and as embracing the same months at all places. Others contend that the terms can be applied to certain portions of the group only. In the islands of Panay, Cebú, and on the west coast of Mindanao, the dry and rainy seasons occur in the same months. The difficulty in applying this division of seasons to the islands of Luzon and Mindanao as a whole lies in their size, which makes it possible for topographic features so to control the precipitation that the wet and dry seasons may vary considerably as to time of occurrence within a relatively small area. This fact has often been noted by travellers, many of whom say that by planning one's route of travel carefully it is possible to avoid the rainy season altogether.

The mean monthly cloudiness for Manila is shown in the following table:

MEAN MONTHLY CLOUDINESS AT MANILA (0–10).

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
4.6	3.8	3.8	3.5	5.1	6.8	7.5	7.5	7.4	6.1	5.8	5.6	5.6

As would be expected, the months of maximum and minimum cloudiness are also the months of maximum and minimum rainfall. The months of maximum temperature, too, may be seen to correspond roughly with those of least cloudiness. The minimum temperature does not show this relation to maximum cloudiness, the former coming in January and the latter in September. The explanation of this fact probably lies in the position of the sun north of the equator at the time of greatest cloudiness.

During the greater part of the year the islands are under the influence of the northeast trade-winds; but the southward extent of the islands brings them under the influence of the diverted south-

east trades—the so-called southwest monsoon. The northeast wind blows during seven months of the year; the southwest wind being felt during the four summer months—June, July, August, and September; May and November have variable winds. At Manila the southwest wind prevails during six months of the year, from May to October; whereas the northeast wind prevails only from February to April. This peculiarity is probably due to some local condition arising from the situation of Manila at the head of a broad-mouthed bay, opening toward the southwest. The farther north one goes, the stronger becomes this trade-wind influence. At Aparri, in the northern part of Luzon, the most prevalent winds, even in the months from July to September, are from the northeast. At Iloilo, in Panay, the most southerly point for which data are obtainable, the prevailing winds during seven months of the year have the northerly components. In the other five months winds from the south and southwest prevail. This station, being 7° 8′ south of Aparri, feels the well-developed southwest monsoon; but even there the southwest wind does not prevail through as many months as at Manila.

Although it has been seen that certain months have a northeast wind, and others a southwest wind, these are not the only wind directions that are noted; nor is there a sudden change from one to the other. In passing from one season to another all the intermediate stages of wind direction are observed. The wind gradually shifts around the compass, in what may be called the transitional season, until it blows prevailingly from the opposite direction. With an east and west extension of the islands, prevailing winds would seem to offer a good basis for a classification of the seasons, but the fact that the southern islands have the southwest monsoon during a longer period makes it impossible to fix upon any seasons which shall comprise the same months in all parts of the islands.

The *baguios*, or typhoons, and the so-called "tornadoes" of the Philippines also need mention. *Baguios* are the oriental equivalent of our West Indian hurricane. They originate in the Pacific Ocean or in the China Sea, in the region bounded by 5° and 20° N. Lat. and 125° and 150° E. Long. These revolving storms are often of great violence, and cause much damage along the low-lying coasts. For example, the typhoon of October 30, 1875, destroyed over 3,000 houses and resulted in the loss of 250 lives. On this account a great deal of careful work has been done at the Manila Observatory, in order to bring the prediction of the baguios to the greatest possible degree of accuracy. At first predictions were based on

barometric indications only. These observations were sufficient as far as an indication of the existence of a typhoon was concerned, but gave no idea of the direction in which the vortex of the storm lay. More recently, the observations of clouds at Manila have been seen to furnish a reliable means of determining both the existence of a baguio and the bearing of the centre. In order to facilitate the determination of the storm's position, and of its probable distance, Father José Algué, Director of the Observatory, has invented his so-called *baro-cyclonometer*. This is an ingenious association of an aneroid barometer and a cyclonometer—the latter being a representation of the surface winds in a typhoon.*

Between 1880 and 1898, February was the only month in which no baguios occurred. During the other months they have been distributed as follows:

BAGUIOS AT MANILA FROM 1880 TO 1898.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
6	0	3	9	24	35	66	63	79	54	40	18	397

The total, 397, represents the number of baguios which passed near enough to the Observatory at Manila to make their influence felt there.

"Tornadoes" in the Philippines are not the same phenomena as our well-known western storms of the same name, but are like our ordinary thunderstorms. That these are very frequent is seen from a record of those occurring at Manila from 1888 to 1897:

"TORNADOES" AT MANILA, 1888–1897.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL.
29	16	89	321	1,003	907	697	621	623	529	168	47	5,050

This gives a monthly average of 1.6 for February, 100.3 for May, and a yearly average of 505 during the ten-year period. Like our thunderstorms, the "tornadoes" are less frequent between 7 and 11 A. M. Worcester speaks of thunderstorms as a regular occurrence shortly after 10 A.M. in Tawi Tawi, one of the most southerly islands†. The majority of more violent storms come in the afternoon; the intensity decreasing towards night.

The early Spanish settlers described the Philippine climate as "Seis meses de lodo, seis meses de polvo, seis meses de todo" (six months of mud, six months of dust, six months of everything).

* A description of this instrument, with illustrations, may be found in Report of Philippine Commission, 1900, Vol. IV., pp. 326–338.

† Worcester: "Philippine Islands and their People," p. 209.

A recent writer, recognizing a different phase of the climate, divides the year into "the small-pox season and the cholera season," corresponding roughly to the familiar classification into wet and dry seasons.* Others have described the climate as "lovely," or "deadly," or "not unhealthy for the tropics." It is hot throughout the year in the Philippines, and oppressively hot during a part of the year. The humidity is prevailingly high, and this, with the constant high temperatures, makes the heat hard to bear, and has an enervating effect on a Northern constitution. Some writers have claimed that people accustomed to the high summer temperature of our southwest will have no difficulty in enduring the heat of the Philippines. The dry air of Arizona and New Mexico, however, offers no parallel to the damp "hot-house" air of Manila. In these States the dry bulb thermometer may truly read 20°–25° higher, but the relative humidity is much less, and the *sensible* temperature, which the body feels, is much lower than in the Philippines. In some months, notably December, January, and February, the Philippine climate is at its best; for during these months the temperature and the humidity are both lower, the rainfall is light, and baguios and thunderstorms are least frequent. In these months, too, the nights are cooler. During the remainder of the year, however, the conditions of heat, humidity, heavy rains, and the greater prevalence of contagious diseases are undoubtedly very trying for Northerners.

Regarding the general situation in which a Northerner finds himself in the climate of the Philippines, Worcester says†:

> The facts are as follows: if one is permanently situated in a good locality, where he can secure suitable food and good drinking water; if he is scrupulously careful as to his diet, avoids excesses of all kinds, keeps out of the sun in the middle of the day, and refrains from severe and long-continued physical exertion, he is likely to remain well, always supposing that he is fortunate enough to escape malaria infection.

The question has also been answered by Maj. Chas. F. Mason, Surgeon 26th U. S. V. I., who says‡:

> If that term [acclimatization] is intended to convey the idea that the constitutions of white men gradually adjust themselves to tropical conditions and thereby become better able to withstand disease, then I do not think there is any such thing as acclimatization. Men do gradually learn to take better care of themselves, and to that extent are less liable to disease, but in my opinion the great majority of white men in the tropics suffer a gradual deterioration of health, and year by year become less and less fit for active service.

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* Hamm, M.A.: "Manila and the Philippines," p. 11.

† Loc. cit., p. 65.

‡ Rept. Surg.-Gen. U. S. A., 1901, 130.

Another officer says *

the most energetic and stalwart American after a year of service in the Philippines loses energy, strength, and ambition. He performs what work his duty demands in a more or less half-hearted way, and with a draft on his vital energy that he can actually feel at the time.

The London *Lancet*,† the leading medical journal in the world, in an editorial in which the experiences of the English in the tropics are largely taken as the basis of argument, maintains

that residence in hot climates under the circumstances of ordinary life has an adverse effect upon Europeans cannot, we think, be doubted. Some constitutions seem to be altogether unfitted for these climates, and such individuals lose their health and physical energy from the moment of their arrival. A still larger number do so sooner or later under a more protracted residence, even if they escape being attacked by one or the other of the endemic or epidemic diseases incidental to such climates. Residence in tropical and sub-tropical countries usually produces a very appreciable effect, not only on the complexion but on the constitution, and notably so during childhood and youth.

Prof. W. Z. Ripley, in summarizing the question of acclimatization as discussed by English, French, and German authorities,‡ says that the almost universal opinion seems to be that true colonization of the tropics by the white race is impossible. But

it must not be understood that by this is meant that the white man cannot live in the tropics. Hygienic precautions and great care often render a prolonged sojourn in these regions perfectly harmless. A colony can, however, never approximate even to the civilization of Europe until it can abolish or assimilate the native servile population; and yet one of the many things which are expressly forbidden to all colonists in the tropics is agricultural labor. . . . Let it be understood, then, that a colonial policy in the tropics means a permanent servile native population, which is manifestly inconsistent with a political independence, or with any approach to republican institutions.

The result of these conditions will probably be that few Americans will settle in the Philippines. A few will be obliged to go there as officials and soldiers; and they, by exercising great care, may live there with a fair chance of good health. The colonizing race must always be in small numbers, while the natives constitute the mass of the population. The separation of these two classes must surely give rise to serious governmental problems, while the native indolence of the Filipino will cause grave problems of labour.

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* Loc. cit., p. 130.

† Lancet, June 3, 1899, p. 501.

‡ Pop. Sci. Mo., XLVIII, 1896, 788–790.

TOPOGRAPHIC SURVEYS OF NEW JERSEY, MASSACHUSETTS AND OHIO.

Over fifteen years ago there was completed a topographic survey of the entire State of New Jersey, which was published on the scale of one mile to one inch, with contours having an interval of 10 and 20 feet. With the State of Massachusetts New Jersey shared the honour of being the first to have such a survey made, and in both cases the resulting maps have exerted potent influence for the development of water and sanitary works under State supervision, and of systems of well-constructed and well-maintained highways.

In both cases this work was executed in co-operation with the United States Geological Survey. Massachusetts left the entire supervision and conduct of the work to the Federal bureau, furnishing half the fund. New Jersey, however, stands alone among the States of the Union in having at first commenced, and in having wisely and economically carried out the survey of its own territory, under the sole direction of State officers. The late State Geologist, Dr. Cook, was in general charge of the Geological Survey of New Jersey, and under him the immediate technical conduct of the work was efficiently executed by Mr. C. C. Vermeule. After the survey was about half finished the State sought and received the co-operative aid of the United States Survey, but those in charge of the latter were so well satisfied with the quality of the work done that they reversed their usual procedure, and left the remaining work to be done by the same able hands, merely supplying the needed funds.

Within the last few years the present State Geologist, Dr. H. B. Kümmel, has undertaken a complete revision of the existing maps, the principal changes found necessary being in culture, chiefly the addition of new roads, streets, railroads, etc. This work is being carried on under Mr. Vermeule. While the results of the first survey were published on a scale of one mile to an inch, the manuscript maps were drawn on a much larger scale. In consequence, the results of the resurvey are being prepared for publication on the large scale of 2,000 feet to one inch for all the more densely-inhabited portion of the State, or at a scale of nearly three inches to one mile.

Already about a dozen map sheets of the new survey have been issued, and they are the most useful and the most satisfactory

topographic maps yet published of any large area of the United States. The scale is so large that it has been possible to add the names of all streets in the cities and villages, and, in consequence, these maps will be found especially useful to those engaged in engineering or allied work in the urban district.

During the present year the United States Geological Survey has taken a hand in this revision, with a view to hastening its completion; and it contemplates the resurvey this season of the unrevised portions of six sheets about High Bridge, Hackettstown, Lake Hopatcong, Somerville, Plainfield, and Morristown, or an area of nearly 1,200 square miles. It is reported, to the great credit of those who made the original surveys on the smaller scale, that practically no errors have been found in culture, and that the contour topographic sketching is remarkably good, though somewhat generalized in places, and lacking the detail shown in the later maps of the Federal survey. Unfortunately, it has not been found possible to incur the expenditure required to revise the contour sketching as well as the culture.

The State of Massachusetts, like New Jersey, did not stop with the completion of its topographic survey, but has been ever since actively engaged on kindred work. It has thus far done nothing towards the revision of the existing maps, but has entered upon a cadastral survey of the commonwealth. This work consists in extending a minute system of triangulation of the highest order of geodetic precision over the State, whereby permanent monuments are located at intervals of a few miles. Several of these are placed on the boundaries of each township, and the outlines of the latter are then traversed with an accurate tape and transit survey tied to the triangulation monuments. The result is to furnish a vast system of precisely-located political and property lines to which all future property lines can be tied. In addition, these cadastral surveys will furnish the instrumental control on which at some future time a thorough and accurate revision of the topographic survey can be based.

This is, in fact, what has recently been done by the United States Geological Survey for the Metropolitan District of Boston, and the result is about to be published in a new edition of the Boston and Boston Bay sheets. Towards the construction of these sheets there were available many hundreds of geodetic positions, chiefly on town boundaries, but including also church spires, factory chimneys, hill-tops, etc. Numerous lines of spirit levels were run over the whole area of survey, and the finished map is of sufficient accu-

racy to furnish a base on which not only to plan but even to project the extension of roads, railroads, and the plans of other engineering works. A preliminary but limited edition of this map, in the form of a black-and-white photo-lithograph, has already been issued on the large scale of over two inches to one mile, and has been found most useful by the various metropolitan bureaux.

Topography of Ohio.

The diverse topographic features of the State of Ohio are well brought out in the series of maps which are rapidly following one another from the presses of the United States Geological Survey, as a result of the liberal appropriations towards co-operative topographic surveys made by the last two legislatures of the State.

Already, after only three seasons of field work, the survey of thirty-two sheets has been completed. These represent the topography, on a scale of one mile to one inch and with contours of 10 and 20 feet, of nearly 6,000 square miles. Two widely-divergent types of topography are represented by the northwestern and the southeastern portions of the State. The Sandusky sheet, for example, had to be mapped with contour interval of 10 feet in order that the very gentle slopes along the low-lying lands on Lake Erie might be properly represented. The country is quite level, the uniformity of the slopes being broken by two features characteristic of the entire lake border series of sheets. These are clearly-defined terraces and benches outlining old lake beaches, and deep-cut ravines which carry the drainage from the uplands to the south into Lake Erie. The old shore-lines, as marked by the beach terraces, are a delight to the student of geology, and these, as well as the deep-cut ravines, are, perhaps, best expressed by the Cleveland sheet, through which the Cuyahoga Creek meanders in a deeply-eroded channel.

In the southeastern portion of the State the higher summits of the country mark the general level of an upland or plateau of nearly uniform elevation and gentle inclination. The surface of this plateau has been deeply and minutely eroded by myriads of little streams draining into the Ohio River. A fine example of this topographic type is shown in the Parkersburg sheet, a preliminary photo-lithograph of which has just been issued. The minuteness with which this exceedingly detailed topography has been mapped is such that the map is very difficult to read; yet had any larger contour interval than 20 feet been used much of the value and accuracy of the map would have been lost.

H. M. W.

GEOGRAPHICAL RECORD.

AMERICA.

PROJECTED RAILWAYS IN CANADA.—Considerable interest attaches to the plan to extend the Grand Trunk Railway of Canada to the Pacific Ocean, its projected line being to the north of the present Canadian Pacific, and to build a new Trans-Canada road still farther north than the Grand Trunk extension. The high latitudes which these roads, especially the Trans-Canada, are to traverse, bring up the question of the climatic difficulties that may be encountered. While it is generally known that Manitoba is a fine wheat country, comparatively few persons yet realize the agricultural possibilities of the great Canadian West. One secret of the success of farming in the western provinces of Canada, east of the Rocky Mountains, lies in the comparatively high summer temperatures over a large portion of the district. During the summer months pretty uniform temperatures prevail in Alberta, the Peace River district, and northward almost to the Arctic Circle. In July the mean temperature at Winnipeg is 66° Fahr., and at Prince Albert 62°, the former being higher than that in any part of England. The average daily maximum temperature at Winnipeg is 78.1°, the minimum being 53.4°, and at Prince Albert the maximum is 76°, and the minimum 48°. It is these high day temperatures in summer, with abundant sunshine and, on the whole, sufficient and well-distributed rainfall, that cause the crops to mature so quickly. The northerly limit of wheat in northwestern Canada is about as far north of the projected Trans-Canada Railway line as that line is north of the international boundary. There is but little snowfall in winter; the warm chinook winds temper the cold near the mountains, and spring begins in the western districts earlier than in the eastern. The great "trek" of American farmers across the border into the Canadian West is recent evidence of the agricultural possibilities of these sections. Besides the grain, there are favourable conditions for cattle-raising, and in the mountains there are vast areas of woodland, as well as rich mineral deposits. The winters are long, but there is not much snowfall, and with plenty of sunshine and a clear, dry air during the colder months, together with a short but favourable summer for crop growth, the Canadian plains are not as inhospitable or as hopeless as they have sometimes been supposed to be. R. DEC. W.

River Surveys in the South.—A most useful geographical and engineering work has been recently begun by the Hydrographic branch of the United States Geological Survey. This is the making of a detailed combined topographic and hydrographic survey of the river systems throughout the United States. Already much related work has been done by the Army engineers below the *fall line* along the coastal borders and greater navigable rivers, in connection with river and harbour surveys. The present survey commences where these stop, and is carried through the Piedmont region and the interior of the country from the fall line to the headwaters of the larger branches.

The purpose is to make an exhaustive study of all those facts which are essential to a full knowledge of the nature, volume, and regimen of the streams, and their value as sources of water supply for power or domestic use. For a number of years past the Survey Bureau has maintained gauging stations, at which the daily and annual mean, maximum, and minimum discharge of the streams are being systematically measured. These results, supplemented by the Weather Bureau records of rainfall on the catchment basins of the streams, and a knowledge of their areas as measured from the topographic maps, furnish all the data from which to ascertain the available water supply of any stream at any time or place.

The additional work now being undertaken in the river surveys consists in making a large-scale contour of each stream bottom for a short distance only outside of the immediately confining banks, accompanied by a careful line of spirit levels. The results are plotted on maps having a scale of about three inches to one mile, with contours of ten feet interval. The profile of the surface of the water is plotted on a suitable scale, and the exact elevations at the tops and bottoms of all shoals, rapids, and falls are determined. Moreover, elaborate notes are made of the stage of waters, floodmarks, cultivated lands, and woods, the whole accompanied by numerous photographs.

As may be readily seen, the resulting maps and reports will furnish all the information necessary to an understanding of the possibilities of every stream in connection with the development of water resources of all kinds. The fall or slope shows the head available for power, and the volumes of flow are known. The maps indicate possible flats for water storage, as well as possible sites for diversion, storage, or mill dams, while photographs and notes give an idea of the topography and of the earth, rock, timber, and other materials of construction. H. M. W.

A Herd of Bison in Northwestern Montana.—The University of Montana, Missoula, maintains a Biological Station near Flathead Lake, in the northwestern part of the State. Professor Morton J. Elrod, Director of the Station, describes in *A Biological Reconnoissance*, published last year by the University, the herd of 220 buffaloes on the Flathead Indian Reservation. The herd, derived from 36 animals purchased in 1884 by Charles Allard and Michael Pablo, has in 20 years increased to more than 350, or ten times the original number. Many of the animals have been sold to show enterprises and to Eastern cities for parks and zoological gardens. The conditions here are more favourable for buffalo than in Yellowstone Park. The animals are constantly attended by a herder, and, therefore, are not afraid of man, while the Yellowstone Park herd is rarely seen.

The Park herd also ranges at a high altitude, over 7,000 feet, where snows are deep and winters are long and severe; but the Flathead herd ranges at an altitude below 3,000 feet, where deep snows do not occur, and hay or grain may be taken to the animals in a few hours. Their range does not exceed 70 to 100 square miles, and the animals might be maintained on a much smaller range. The cows do not bear calves until they are 4 or 5 years old, and about half of them produce every year. The fertility of the herd is not decreasing. The herder keeps note of the increase, looks after the calves, and, in fact, the animals are much more carefully attended than the range cattle among whom they graze.

Professor Elrod is of the opinion that the success of this private enterprise should stimulate Congress to increase its efforts to save the buffalo from extinction. An appropriation of $8,000 would buy as large a herd as Allard and Pablo purchased in the beginning. With the same care the herd should increase to between 400 and 500 in twenty years. If a tract of land containing from 50 to 100 square miles were set apart for a buffalo range, with an appropriation at the start of $15,000, and an annual appropriation of $5,000, there would be no difficulty in developing a herd that would be a credit to the nation. The care of the herd should be placed under the jurisdiction of the Biological Survey of the Department of Agriculture. It is hardly to be expected that the animals will thrive in Yellowstone Park, where the winters are long and severe, the summers short, and protection is afforded to wild animals, which prey upon the calves.

AFRICA.

MINERALS IN GERMAN EAST AFRICA.—Mr. Max Moisel has prepared a map of German East Africa on a scale of 1:2,000,000, showing the existing knowledge of its topography, and the distribution of useful minerals as far as they have been discovered. The map is reproduced on a smaller scale in the *Deutsche Kolonialzeitung* (No. 15, 1903). Placer gold has been found along the banks of some of the rivers, both near the south coast of Victoria Nyanza and between Lake Nyasa and the Indian Ocean. Among the Useraguru Mountains, near Emin Pasha Gulf, Victoria Nyanza, outcrops of gold-bearing quartz have also been discovered. It is expected soon to work some of the placer diggings. Iron is very widely distributed; excellent anthracite is found near the northern shores of Lake Nyasa, but beds of bituminous coal brought to light appear to be of inferior quality. Lead, copper, granite, kaolin, bitumen, mica, lignite, and agates are among other mineral resources which may some day prove profitable.

THE TUBURI SWAMP.—About half a century ago, Heinrich Barth discovered a widespread swamp to the west of Lake Chad which appeared to be so perfectly balanced on the water-parting that, in his opinion, it was drained partly into Lake Chad and partly into the Atlantic Ocean. This connection between the Chad and the Atlantic drainage system has now been proved to exist. The solution of the question has devolved upon the French expedition commanded by Capt. Loefler. Starting from Carnot, the chief station on the upper Sanga, he crossed the water-parting (850 metres above sea-level), between the Sanga, the Mobangi, and the Shari.

BIBLIOGRAPHY OF MOROCCO.—The exhaustive bibliography of Morocco to the end of 1891, prepared by Sir L. Playfair and Dr. R. Brown, and containing 2,243 titles (*Supplementary Papers* of the Royal Geographical Society, Vol. III, Part 3), is now supplemented by the bibliography attached to Mr. Camille Fidel's long paper "Les Interêts Economiques de la France au Maroc" (*Bulletin Trimestriel* of the Oran Geographical and Archæological Society, No. 94), in which he includes the most important works on Morocco since 1891—a period that has been peculiarly rich in literature on that country. Mr. Fidel's list embraces those books and papers which are specially valuable in an economic sense.

ASIA.

GERMAN COLONY OF KIAOCHAU.—Dr. Georg Wegener, in an

article in the *Geographische Zeitschrift* (1903, No. 4), says that the harbour of Kiaochau Bay does not fill all desirable conditions. The bay is so large that the northwest storms, frequent in winter, endanger the shipping. This difficulty will be obviated, however, by the completion of the mole, which will be 4½ kilometres in length, 5 metres in width, and 5 metres above high tide. Under the protection of this mole two havens are being built. The smaller has, in fact, been completed, and is now utilized by vessels drawing not more than 5 metres. The larger, adapted for the greatest ocean vessels, is nearing completion. The dry dock, which will be the largest on the east coast of Asia, will be ready for use in 1904. The bay is undoubtedly the best harbour north of the Yangtse; but its potentialities for fostering the growth of trade are latent, and must be developed by the great commercial Power that now holds it. Trade with the populous interior will be created chiefly through the railroad now building from the Bay to western Shantung. Great improvements have been made at Tsing-tau, the starting-point of the railroad, and the port of the Bay. Wide, well-built streets, commodious dwellings and business houses, and healthful barracks for the troops have been constructed. A large lighthouse is building at the entrance to the Bay.

AUSTRALIA.

THE PROPOSED TRANS-CONTINENTAL RAILWAY IN AUSTRALIA. —The projected railway across Australia, from Adelaide on the south to Port Darwin on the north, a distance of 1,896 miles, is to cut right through the central portion of the country, and is one of the many interesting railway enterprises of the present day. On the south the railway now reaches Oodnadatta, 683 miles north of Adelaide, and on the north it is built from Port Darwin to Pine Creek, a distance of 145 miles. As to the climatic conditions of the great interior district which is to be traversed, very little is known. It used to be thought altogether a hopeless desert. Then came reports that the climate around the MacDonnell Range was "splendid" and the country very fertile. Later, the Horn Expedition resulted in modifying the too favourable opinion which had been formed by the natural reaction from the earliest ideas. Horn found the ranges bare ridges, separated by sandy flats. In 1862, McDouall Stuart made his third, and successful, attempt to cross the continent from south to north. He found that the Bonney River, in latitude 20° 24′, which when last seen in March was a fine stream, in September was a series of water-holes. The

tracks of the expedition of the previous year were plainly visible, which showed that no rain had fallen in the meantime. Central Australia evidently shares with other arid regions the characteristic of having great irregularity of rainfall from year to year. The MacDonnell Range receives occasional heavy showers, which fill up the streams and even flood the lower country. When a traveller comes at such a time he finds a luxuriant growth of vegetation; while one who comes later or earlier may take back a very different story. Over the central portion of the route to be traversed by the railway the rainfall may average about five inches a year; but towards the northern end of the line, in the Northern Territory proper, or Arnhem Land, there is more rainfall and a possibility of vast wealth. In the north, rice, sugar-cane, tobacco, and coffee flourish; while to the south the greater part of the country is suited for breeding sheep, cattle, and horses. It has been stated that the country may be expected to carry 30,000,000 sheep. In supporting the railway bill, the Premier of Australia recently said: "The territory is bound to became the great cattle-producing country of the world; no other part is so suitable for cheap and extensive production."

R. DeC. W.

CLIMATOLOGY.

Climatic Control of Railroad Construction and Operation.—In the construction and operation of railroads in different parts of the world, many of the chief difficulties encountered arise from the climatic conditions of the regions traversed. Some of these difficulties, and the way in which man has met them, are considered in a recent article on *Climatic Factors in Railroad Construction and Operation*, by Robert M. Brown (Journ. Geogr., April, 1903, 178–190). The railroad districts of the world are classified by the author into Regions of Heavy Precipitation; Regions of Moderate Precipitation; Regions of High Altitudes, and Regions of Severe Winters. In the first of these districts, where the rainy seasons usually alternate with dry seasons, much trouble arises from the fact that the ties decay, and have to be preserved by creosoting, or else must frequently be renewed. In any case the expense involved is very considerable. During the dry season the hot sun may warp and split the sleepers so that they must be renewed, and there is also difficulty in supplying the labourers with pure water. Early in the history of the Sind Railway, in India, a system of water-carts and bullocks, and later of water-trains, was organized for carrying drinking water to the men. The scanty supply of pure water for

use in the locomotives is another serious handicap. The number of working days is much decreased by the heavy rainfall of the wet season and by the excessive heat of the dry season. In the construction of one road in India work was impossible between 9 A.M. and 4 P.M. During the rainy season "the history of every road that traverses the belt of heavy precipitation is a story of continued struggle against flood" and landslides. In Ceylon a rainfall of 28.56 inches in eleven days caused so many landslides near Nanu that traffic was interrupted for six weeks, and the La Guayra and Carácas Railroad, in Venezuela, is frequently similarly blocked during the rainy season. On the other hand, in the dry season much difficulty has been experienced because of the damage to machinery and bearings through dust.

Regions of light precipitation, which include the deserts of the world, present climatic problems to the engineers which are often very difficult to solve. The great danger from fire in the case of ties, bridges, and buildings often necessitates fire stations and fire patrols. Water has to be carried or piped for long distances, as in the case of the Southern Railway of Peru and of the Iquique Railway of Chile. Work has often to be suspended during the noon hours. The absence of wood and coal for fuel has, in several cases, led to the use of oil. Blowing sand covers the tracks, and necessitates the employment of labourers to keep the road cleared.

In regions of high altitudes there are the difficulties which arise from mountain sickness and from the cold, both during the construction and after the completion of the road. A part of the new Jungfrau Railway is run through a tunnel to protect it from the winter snow blockades, which are serious handicaps to many railroads. It cost the Colorado Midland Railroad $60,000 to clear its track of snow during the late winter of one year recently.

The Trans-Siberian road is a good example of a railroad built in a region of severe winters. Temporary rails were laid on the ice during the period of construction, and ice-breakers have been employed to keep Lake Baikal open, so that the cars may be ferried across.

R. DeC. W.

LONDON FOGS.—Captain Alfred Carpenter, R.N., who has been conducting the official inquiry into the occurrence and distribution of fog in London, has presented a report to the Meteorological Council of the Royal Society on the results obtained for the year 1901–02. Among the most important conclusions thus far reached are the following: The commencement of a fog is a general process,

depending upon general atmospheric conditions. There is no evidence that fogs formed outside invade or drift into London. London fogs are produced in London. During dense fogs in London there is a tendency to an indraught of air from all sides to the central parts of the city. No severe fog occurred with a temperature above 40° Fahr. On March 7, during a fog, the temperature in the streets was nearly 10° Fahr. below that on the roof of the Meteorological Office, at the elevated stations, and over the surrounding country on the south and west. It is proposed to carry on the investigation, and especially to study the vertical decrease of temperature before and during fogs. R. DeC. W.

PHYSICAL GEOGRAPHY.

Volcanic Eruptions in Samoa.—The German Government received, in February, official and private accounts of the volcanic eruptions which began in Savaii, the largest and most western island of the Samoan group, in October last. Dr. Georg Wegener, of Berlin, has an article based on these reports in the *Zeitschrift* of the Berlin Geographical Society (No. 3, 1903), from which the following facts are taken:

The eruptions were a great surprise to the islanders; though the entire group is formed of volcanic outpourings, excepting the little atoll Rose and a number of coral reefs, no evidences of existing energy at the present time were known. There were no solfataras, fumaroles, or hot springs to show that plutonic energy was not entirely extinct. Since the recent outburst a half-forgotten tradition has been revived, to the effect that long ago, perhaps about 1690 A.D., a very severe eruption on Savaii destroyed ninety-five villages. This story must, however, be received with reserve. It is evident that vulcanism in the archipelago gradually subsided from the east to the west, the eastern islands being evidently older than those in the west. In the Manua and Tutuila groups (United States) of the east, for example, the ancient craters have entirely or to a large extent disappeared through denudation, while in the western island of Savaii well-formed craters still remain. The larger denudation and the formation of humus in the eastern islands have also resulted in a deep rich soil, while in Savaii a great part of the island is not adapted for tillage. These facts are interesting to us in their bearing upon the non-liability of our island Tutuila to suffer from such disasters.

The news of the eruption was brought to Apia, the capital of German Samoa, on Upolu island, on November 2, by an English-

man named Williams, who crossed from Savaii in an open boat. He said that severe earthquakes, which overturned stone walls, were felt on the north coast on October 29th. "Smoke" was seen to be rising above the interior mountains on the 30th, and that night subterranean rumblings were heard. These phenomena continued up to the time that Williams left the island. Dr. Schnee, Governor of German Samoa, and Dr. Tetens, the astronomer, went to Savaii on November 3d. That evening they observed flames rising to a height of 100 to 200 metres about 17 miles southwest of south from Mataatu, the chief town of the island on the northeast coast. The natives along the north coast had been greatly alarmed, and most of them fled to the east.

On November 7th a very severe earthquake occurred, which badly damaged several Mission churches in Safune and Sasina, on the coast, and destroyed the village of Paia. On the same day Dr. Tetens, in the midst of a hard rain, pushed inland, and on the following day he camped, at a height of 1,460 metres above the sea, in the neighbourhood of Manga Afi, a long-extinct volcano, within plain view of the column of dust and fire-glow that was rising above the trees. The seat of the explosion was on the slope of Manga Afi, about 50 metres below the old crater at its summit, and about three-fifths of a mile from it. The ascending dust column varied in strength from time to time. Glowing bodies at very frequent intervals were ejected to a height of about 100 metres, most of them falling back into the opening. The scene did not give an impression of great energy. The crater edge could not be seen on account of the burned timber around it. A remarkable discovery was made about 3 kilometres northwest of the crater. A rough wall or ridge of pumice-like stone, measuring from 10 to 50 centimetres or more, and still so hot that the barefooted Samoans could not step on it, rose to a height of 5 to 10 metres. This "stone stream," which undoubtedly came from the new crater, and was about 150 metres lower down the slope, was from 5 to 10 metres in height. Its width and length were not ascertained. No flowing lava was observed.

On November 18th, Surveyor Lammert approached the centre of disturbance from the south side of the island, and found another active crater from 600 to 800 metres southwest of the one which Dr. Tetens had discovered. He also found that the crater which Tetens approached had an east-west axis 800 to 1,000 metres in length. Through five or six cracks in the surface of the slope, also, little shoots of flame rose to a height of only one to two metres. The

air at times was so charged with gases that it was difficult to breathe. All vegetation had been destroyed near the craters, and the forests were burning for a considerable distance around. Herr Lammert was not able to reach the crater he had discovered, but saw that its activity was increased after a sharp earthquake shock.

No further news has been received. Dr. Wegener is of the opinion that the eruptions have subsided, or at least have not intensified, for otherwise vessels arriving in Australia or San Francisco would have reported the fact. He calls attention to one interesting feature. It is generally supposed that the degree of energy displayed by a reawakened volcano is proportioned to the length of its period of rest; the longer the period, the more violent the outburst when it comes. In Savaii, however, though apparently no volcanic outburst had occurred for some centuries, the energy of the recent eruption has been comparatively unimportant; the subterranean power seems to have found some easy way to reach the outer air.

FORMATION OF BARRIER REEFS AND DIFFERENT TYPES OF ATOLLS.—Professor Alexander Agassiz has summarized his results, based upon observations of barrier reefs and atolls, carried on during the past twenty-five years, for the *Proceedings* of the Royal Society (No. 474, 1903). He recognizes the fact that Darwin's theory does not explain the conditions now observed, but limits his report to descriptions of the different types of coral reefs and of their probable causes, without attempting to establish any independent theory. He has found that the barrier reefs of Fiji, Hawaii, and the West Indies are underlaid by volcanic rocks and usually flank volcanic islands. Those of New Caledonia, Australia, Florida, Honduras, and the Bahamas are underlaid by outliers of the adjoining land masses. Some of the barrier reefs of the Society Islands, Fiji, and the Carolines show that the wide, deep lagoons separating them from the land mass were formed by erosion from a broad, fringing reef flat. Encircling reefs, as in the Society Islands, hold to their central island or islands the same relation which a barrier reef holds to the adjoining land mass. Denudation and submarine erosion account for the formation of platforms upon which coral and other limestone organisms may build either barrier or encircling reefs, or even atolls rising upon a volcanic base.

We may trace plateaux that have been elevated, like Guam, partly volcanic and partly limestone, to atolls where only a small islet or a larger island of either limestone or volcanic rock is left

to indicate its origin. Atolls may also be formed upon the denuded rim of a volcanic crater, as at Totoya, in Fiji. Many of the atolls in the Pacific are merely shallow sinks formed by high sandbanks thrown up around a central area. Throughout the Pacific, the Indian Ocean, and the West Indies the most positive evidence exists of a moderate recent elevation of the coral reefs. Closed atolls can scarcely be said to exist; Niau, in the Paumotus, is the nearest approach to one, yet its shallow lagoon is fed by the sea through its porous ring. The land area of an atoll is relatively small compared with that of the half-submerged reef flats. In the Marshall Islands and the Maldives, for example, the land areas are reduced to a minimum. Atolls may rise from a platform of suitable depth wherever and however it may have been formed and whatever may be its geological structure. The great coral reef regions are within the limits of the trades and monsoons and the areas of elevation, with the exception of the Ellice and Marshall Islands and some of the Line islands. Corals have their fullest development on the sea face of reefs; they grow sparingly in lagoons where coralline algæ grow most luxuriantly. Nullipores and corallines form an important part of the reef-building material.

ECONOMIC AND COMMERCIAL GEOGRAPHY.

WESTERN MOVEMENT OF COAL IN THE UNITED STATES.—In the entire region between the Appalachian coal field and the Rocky Mountain fields a general Western movement of the coal is observed. Thus the product of the Western Interior field (the coal-belt from north Iowa to central Texas) goes West almost exclusively; that of the Eastern Interior field (portions of Indiana, Illinois, and Kentucky) goes West to and within the borders of the Western Interior field, while the Appalachian coal goes west across both the Eastern and Western Interior fields and beyond the territory of the latter, competing with the Rocky Mountain coals to some extent. This westward tendency is due chiefly to the higher grade of Eastern coal; in part, also, to the fact that railroad freight rates are generally lower westward than eastward; water transportation also favours the westward rather than the eastward movement of coal (*Contributions to Economic Geology. 1902. Bulletin* No. 213, United States Geological Survey).

HENEQUEN IN YUCATAN.—Consul E. H. Thompson, of Progreso, Yucatan, contributes to *Advance Sheets* of the Consular Reports (Feb. 28, 1903) an interesting account of the chief product of

Yucatan. Sisal grass, sisal hemp, henequen, or simply sisal, are names applied to a fibre that is neither a grass nor a hemp, and is not produced to any extent in Sisal. The name sisal was given to it because, until 1871, Sisal was the only port through which it was exported. When a railroad built to Progreso gave a shorter route to the coast, the exports were entirely transferred to that port. Its wharves are now lined with shipping, and the streets are filled with bales of henequen ready to be sent out in exchange for the general merchandise that comes in. The *Agave americana* produces the pulque, which is the national beverage of Mexico. Another member of the agave family, the *Agave sisalensis*, supplies the fibre which is so widely used in our country for cotton sacking, binders' twine, rope, and other articles. The cultivation of henequen was not important till the invention of fibre-cleaning machinery. With the aid of one machine two men can now clean more fibre in a day than forty were formerly able to do. There are five different machines, each of which can strip the fibre from 150,000 agave leaves in ten hours. The output has steadily increased for ten years, and amounted in the fiscal year ending June, 1902, to 564,308 bales.

BRAZIL RUBBER.—Mr. A. Kähler, who has spent five years on the Amazon, gives an interesting account in *Petermanns Mitteilungen* (February, 1903) of the methods of collecting rubber in the forests of Brazil. Rubber of the best quality and largest quantity comes into the trade under the name of Pará rubber or Pará-fina. The tree from which it is derived (*Siphonia elastica*) is widely spread over the lowlands, and thrives best where the land in the rainy season is almost completely flooded. It has a straight, silver-coloured trunk, and attains a height of 60 to 80 feet. The collector requires about two hundred trees, collecting sap from half of them on one day and from the other half on the day following, thus alternating through the season, which covers the drier months from May to October. The workman goes from tree to tree, making short incisions through the bark with a small hatchet. Under each incision he presses into the bark the sharp lip of a tin cup, which catches the sap. The incisions close completely in about two hours, when the cups are collected and the sap is carried to his hut. The afternoon is given to smoking and coagulating the morning's collection. The average amount gathered by a collector in the season is from 400 to 500 kilograms, which usually sells in Europe for about $1.85 a kilogram. There is scarcely any vegetable product that brings so high a price as Pará rubber. It is usual to

give the *siphonia* a rest of a year after it has yielded annually for four or five years. Plantations for the cultivation of this tree have been started, but the cultivated *siphonia* seems to yield less sap than the wild tree, and the product is of poorer quality. The other variety of Brazilian rubber is extracted from the caoutchouc tree, also widely distributed; it seems likely to be exterminated, because the tree must be destroyed to obtain the sap. The milk runs so rapidly that no way has yet been discovered of collecting it while the tree is standing. The *siphonia*, on the other hand, may be counted upon as a great and permanent resource.

Live Stock in Germany.—The following figures, condensed from a table in *Vierteljahrshefte zur Statistik des Deutschen Reichs* (Ergänzungsheft zu 1903), show the number of live stock (the larger classes) in Germany in three census years; the decline in the sheep industry has been very marked:

	1873.	1892.	1900.
Horses.......	3,352,231	3,836,273	4,195,361
Cattle........	15,776,702	17,555,834	18,939,692
Sheep........	24,999,406	13,589,662	9,692,501
Swine........	7,124,088	12,174,442	16,807,014
Goats	2,320,002	3,091,508	3,266,997

Freight Haulage in Madagascar.—The excellent wagon roads, completed in 1901, between Antananarive, the capital of Madagascar, and the ports of Tamatave, on the east, and Majunga on the west coasts, have revolutionized the methods of freight carriage. Human porterage has been almost entirely supplanted by freight wagons hauled by men. In the last six months of 1902, 4,026 freight wagons were hauled to Antananarive by 11,831 men, all but 156 wagons starting from Tamatave. In the same time only 505 porters carried loads between the sea and the capital, though, in 1901, 48,600 men were engaged in the porterage service. The economy of the new method of carriage is illustrated by the fact that the freight in 1902, carried by wagons hauled by 23,590 men, would have required 62,418 men to carry it on their backs. Haulage by mules and oxen is still small, but is increasing (*Bulletin Économique*, No. 4, 1902).

Manufacturing Industries in Sweden.—From 1896 to 1901 the number of manufacturing establishments in Sweden increased from 8,812 to 10,904; of workpeople in them from 202,293 to 262,229; and the total value of the product from $192,487,400 to

$285,010,200. Saw mills contributed, in 1901, 13.53 per cent. of the total value of product; flour mills, 7.70 per cent.; textile mills, 5.22 per cent.; machine shops, 5.14 per cent., and iron and steel manufactures and foundries, 5.01 per cent. (*Bidrag till Sveriges Officiela Statistik.* Fabriker och Handtverk, 1901).

THE WORLD'S CEREAL CROPS IN 1902.—The world's yield of cereals in 1902, as estimated by *Broomhall*, was: Wheat, 3,072,000,000 bushels; maize, 2,975,000,000; oats, 3,172,700,000; barley, 1,027,100,000; rye, 1,518,000,000. The United States produced 84 per cent. of the world's maize and 22 per cent. of the wheat. Russia produced 40 per cent. of the barley and 55 per cent. of the rye.

MAPS AND CHARTS.

THE BEST MAPS.—Professor Israel C. Russell, of Michigan University, gave an address before the Michigan Academy of Science, at its ninth annual meeting, on topographic maps and the topographical survey of Michigan. He said the most enlightened nations of Europe are in advance of all others in the completeness and accuracy with which their domains have been surveyed and mapped. Germany, France, and England, in particular, have excellent maps of their territory, and, in many instances, most conspicuously in the case of the English in India, the same desire for accurate information has been extended to their colonial possessions. Similar maps embracing any considerable areas in America were almost unknown up to the organization of the United States Geological Survey in 1879. Even at the present time creditable maps of the entire area of only four States are at hand; and in Michigan less topographic work has been done than in any other State, with the exception of Florida and Minnesota.

These best maps, in addition to representing the relative positions of objects on the earth's surface, indicate with equal accuracy the heights and shapes of mountains and hills, the forms of valleys and the slopes of their enclosing uplands. In brief, such maps represent portions of the earth's surface, in three dimensions, by means of three co-ordinates—namely, latitude, longitude, and height above or depth below sea-level.

Professor Russell described contoured topographic maps, their advantages and uses, and enlarged upon the need of them as the basis for carrying out a wide range of enterprises. Several States, for example, ignored the fact that the results of geological surveys may be accurately laid down only upon a topographic map, with

the result that their geological work was in large part provisional and in most cases re-surveys became imperative, and thus much time and money were wasted. Speaking of the topographic survey of Michigan, he quoted Mr. C. A. Davis, who had made a preliminary study of the forest preserves of the State, and said that the existing maps, with the exception of those of small areas produced by the United States Geological Survey, were so inaccurate that they gave none of the data demanded, even for the intelligent location of a farm or a forest.

If Professor Russell's address were read by a large number of our people it would help to create the public sentiment, which is sorely needed, to influence our private map houses to improve the quality of their maps, in which respect this country now lags wofully behind all the other leading nations of the world.

Pilot Charts of the South Atlantic and South Pacific Oceans.—The monthly Pilot Charts of the North Atlantic and North Pacific Oceans, issued by the United States Hydrographic Office, are well and favourably known to seamen of all nationalities. They present, from month to month, the latest and most accurate information obtainable regarding winds, fog, ice, storm tracks, wrecks, etc., over these oceans. From year to year these charts have been improved and have become more valuable. Within a few years the British Meteorological Office began to issue similar charts for the Atlantic Ocean. Information now comes from the United States Hydrographic Office to the effect that it is proposed to publish charts of the South Atlantic and South Pacific Oceans, similar in scope to the present North Atlantic and North Pacific charts. The proposed charts will be published quarterly instead of monthly, the first to appear being the South Atlantic chart for the winter months of 1903–04, which it is hoped to have ready for distribution November 1, 1903. Successive seasonal charts of the South Atlantic will appear at quarterly intervals until the first year has been completed. Then the series for the South Pacific Ocean will be begun.

R. DeC. W.

GENERAL.

The Ninth International Geological Congress.—The next meeting of this Congress will be held on August 20–27, inclusive, in Vienna. The president of the committee in charge is Dr. Emil Tietze, Director of the Imperial Geological Office; the Secretary is Prof. Dr. C. Diener. The proceedings will include three principal

topics: 1. The present standpoint of our knowledge of crystalline schists, with papers by Profs. F. Becke, C. van Hise, P. Termier, F. E. Suess, A. Sauer, J. Sederholm, and L. Mrazec. 2. The Problem of Over-thrusts, with papers by Profs. V. Uhlig, M. Lugeon, F. Törnebohm, Bailey Willis, and F. Kossmat. 3. The Geology of the Balkan Peninsula and the Orient, with discussion by Profs. F. Toula, V. Hilber, J. Cvijic, G. v. Bukowiki, F. Katzer, and A. Philippson. Other papers of general interest and the reports of various scientific commissions are included in the programme. A number of very interesting excursions have been planned, including visits to the paleozoic region of central Bohemia, the thermal zone, and the eruptive districts of north Bohemia, the petroleum fields of Galicia, the salt regions of Salzburg, the Iron Gates of the Danube, Belgrade, and other points of interest, as well as short excursions during the sessions of the Congress to the environs of Vienna. The complete programme, with approximate estimate of the cost of excursions, may be obtained by applying to Prof. Dr. C. Diener, Vienna 1, Bartensteingasse 3 (*Petermanns Mitteilungen*, No. III, 1903).

Dr. Neumayer Retires.—Dr. G. V. Neumayer, the well-known meteorologist and geographer, on April 1 gave up the directorship of the Deutsche Seewarte at Hamburg, of which he had been in charge since 1876.

Death of Dr. Gustav Radde.—*Globus* (16, 1903) reports that Dr. Gustav Radde died at his home in Tiflis on March 16th last, in the 72nd year of his age. He was specially distinguished for his numerous contributions to the geography of animals and plants. His studies and explorations took him over a large part of north and central Asia, the Caucasus, and, to some extent, into tropical Asia. His greatest work was the founding of the Museum of Natural History, Ethnology, and Antiquities at Tiflis. He wrote a number of books, and was a frequent contributor to *Petermanns Mitteilungen* and its Supplements.

The Largest Vineyard in the World.—*La Géographie* (April, 1903), in an article on "Agricultural Economy in Portugal" by M. Ch. Flahault, prints a striking view of the largest vineyard in the world, at Poceirao. It contains 2,400 hectares (5,930 acres), on which are planted 6,000,000 vines, annually producing more than 100,000 hectolitres (about 2,650,000 gallons) of red and white wine.

NEW MAPS.

AMERICA.

PENNSYLVANIA.—General map of the Anthracite Coal Fields of Pennsylvania. Compiled by Wm. W. Ruley, Chief of Bureau of Anthracite Coal Statistics, Philadelphia. *United States Geological Survey.*

A chart showing in colours the Wyoming, Lehigh, and Schuylkill regions into which our great anthracite fields are divided; also a diagram showing the annual production of anthracite in Pennsylvania since 1820, and the amount produced by each region.

CANADA.—Manitoba. Scale, 1:792,000, or 12.5 statute miles to an inch. Department of the Interior, Ottawa. 1902.

A Land Office map showing that nearly all the southern half of Manitoba and a wide section through the northwest part of the province along the line of the Canadian Northern railroad have been subdivided by surveyors, the still unoccupied lands being thus ready for appropriation by settlers. The Land Offices, boundaries of the Land Districts, drainage features, and railroads are shown. The surprising development of railroad building in southern Manitoba has made Winnipeg a large railroad centre.

NORTHERN BOLIVIA.—Mapa de las Vias Terrestres y Fluviales que Conducen al Territorio Nacional de Colonias. Scale, 1:4,000,000, or 63.1 statute miles to an inch. Published by the Bolivian Government. La Paz. 1903.

This is a useful map, issued by Bolivia for the convenience of exploring and surveying parties and settlers in the northern and still little-known parts of Bolivia, a heavily-forested region with rich resources, particularly in rubber. It shows the Mamoré, Beni, Madre de Dios, Aquiri, and other rivers, indicating ports and limits of navigation in red and tracing in yellow the overland routes between the rivers. It includes the best delineation of the disputed Acre territory that has yet appeared. The map illustrates an official pamphlet giving all that is yet known of the geography of this region, describing its exploration, resources, conditions of navigation, climate, and method of government.

EUROPE.

MONTENEGRO.—Montenegro und sein Eisenbahnprojekt. Scale, 1:1,000,000, or 15.7 statute miles to an inch. *Deutsche Rundschau für Geographie und Statistik.*

Showing the route of the projected railroad from Niksic, in the heart of Montenegro, south to the northern corner of the Principality's short coast-line and with a branch to Cetinje.

ASIA

ASIA MINOR.—Karte von Kleinasien. In 24 sheets. Scale 1: 400,000, or 6.3 statute miles to an inch. Sheets A iv Sinob, A v Unie, B iv Jozgad, B v Siwas, C Konia, C iv Kaisarie, D iii Ermenek, and D iv Adana. By Dr. Richard Kiepert. Dietrich Reimer (Ernst Vohsen). Berlin, 1902.

These eight sheets of Dr. Kiepert's excellent map of Asia Minor mark the completion of one-third of the work. In the better-known regions elevations are shown

by brown tints. The relative value of the materials upon which the map is based is indicated by differences in drawing and lettering. The routes of many explorers are given. Dr. Kiepert is using, with great pains and critical judgment, all available material in the preparation of this very careful map, which, with corrections and additions, will undoubtedly be the standard map of Asia Minor until a detailed survey of the region is made.

LAKE CHAD.—Région du Tchad. Seven small maps of the southwestern part of Lake Chad and its Shari and Bahr el Ghazal affluents. By Captain J. Truffert. *Revue de Géographie.* June, 1903. Paris.

These maps especially illustrate the partial filling of the east portion of Lake Chad with an enormous number of long, narrow islands, all extending in a northwest and southeast direction, and owing their origin, shape, and great number to the distribution of sand and alluvium through the agency of the currents and winds.

KAMERUN.—Das Nordwestliche Grenzgebiet von Kamerun zwischen Rio-Del-Rey und Bali. By Max Moisel, after new surveys by Glauning, Ramsay, Lessner, Meyer, Strümpell, and Buthut (1900–1902), combined with earlier data. Scale 1:250,000, or 3.9 statute miles to an inch. Two sheets. *Mitteilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten.* 1903. Berlin.

This finely-executed map gives an accurate representation of the large northwestern part of Kamerun along the German-British boundary, which has been the scene in the past two or three years of much commercial activity. It is seldom that so good a map closely follows wholly inadequate maps of the same region. It shows many important and long-known places upon the bases of accurate route surveys and astronomical place determinations; the result is that the mapped position of these places is considerably changed, Bali, for example, being assigned to 5° 53′ 18″ N. Lat. instead of 6° 30′, according to Zintgraff. The large scale permits the insertion of an unusual amount of information.

THE WORLD.

THE WORLD.—Le Réseau Mondial des Câbles Sous-Marins. Mercator Projection. *Revue de Géographie,* Paris. May, 1903.

Showing all the sub-marine cables, coloured according to the nations controlling them: also projected cables, transcontinental telegraph lines, and railroad lines that are most important in international trade.

ATLASES.

ATLAS DES COLONIES FRANÇAISES.—Dressé par ordre du Ministère des Colonies. Livraison 9. By Paul Pelet. Librairie Armand Colin. Paris.

Part 9, completing this excellent Atlas, contains 3 sheets: *Afrique Française,* on a scale of 1:14,000,000, showing north Africa as far south as the mouth of the Congo, with the boundaries of the French colonies. The routes of explorers, the railroads, aud all other leading information are clearly expressed by omitting minor detail. *Colonies Françaises,* a map of the world on the equivalent projection, shows the French colonies in red, and those of all other countries in green. *Points d'Appui de la Flotte* contains 7 small maps of colonial harbours on a scale of 2:200,000, or 3.1 statute miles to an inch; and a plan of Bizerte and Goulet du Lac on a scale of 1:50,000, or 0.7 statute mile to an inch. An index, bibliography, and description of all the regions mapped accompany this last instalment of the Atlas.

South Africa.—The Union-Castle Atlas of South Africa. Twenty-one coloured plates, containing 36 maps and diagrams. An Index of over 6,000 names. The Union-Castle Mail Steamship Co., Ltd. London. 1903.

This is a very excellent atlas. The plates, made by George Philip & Son, Ltd., of London, are of high merit, and present a large amount of accurate information. The sheets include geologic, rainfall, physical, political, and industrial maps. This may be the first time that the three coal fields, a little south of the Zambezi, have been shown in an atlas. The Cape to Cairo railroad is now being built to the Wankie's, east of Victoria Falls, and it is expected that the superior coal found there will be widely distributed through South Africa. The political maps are coloured to show the division into counties and districts; and a particularly useful feature is the plans of the leading towns, on a large scale. The plan of Cape Town, for example, shows all the streets and the positions of principal buildings, the Botanical Gardens, parks, reservoirs, docks, and quarries. Two plates are devoted to the Witwatersrand, showing all the reefs and the names of the mines situated on them. The railroad map gives every station along the various lines. Accompanying letterpress gives an interesting account of the history, geographical features, climate, resources, game, and people of South Africa. The atlas is sold at $1, merely covering the cost of production, at the New York office of the Union-Castle Co., Nos. 8–10 Bridge Street.

New York. Geologic Map of New York of 1901. Exhibiting the Structure of the State so far as known. Scale, 5 miles to an inch. By Frederick J. H. Merrill, State Geologist, Albany, N. Y., 1903. Price, in atlas form, $3; mounted on rollers, $5.

This map succeeds the late Professor Hall's *Preliminary Geologic Map of New York State of 1894*. That map was beautifully engraved on copper, but, owing to the incompleteness of the State surveys, the errors were so numerous that it was thought best not to correct the plates for the present edition, but to issue the new map by the less expensive method of photo-lithography and leave the engraving of a new copper-plate base to the time when the topographic surveys of the State are completed; then the geologic data may be placed upon a map whose substantial accuracy is undisputed.

The geographic base of the present map is all the topographic sheets prepared up to the time of compilation and the best county maps for the remainder of the State. All the latest geologic material was brought together in the compilation of the map; but a number of the geologic boundaries are still necessarily conjectural, some because they have not yet been carefully surveyed on topographic sheets; and some because the extent of the Quaternary deposits is so great as to render these boundaries, in a large measure, indeterminate. The boundary between the Niagara and Salina formations west of the Genesee River, for example, may never be defined unless a very extensive system of borings be made. The colors and patterns used to indicate the geologic formations are, as nearly as possible, those used by the United States Geological Survey in its maps. The names applied to the formations follow closely the nomenclature employed in most of the text-books now in use, which will doubtless be a convenience to the student and teacher. Dr. Merrill, Dr. Clarke, the State paleontologist, and others who spared no effort to make this map entirely worthy of our existing knowledge and present facilities for mapping it deserve the thanks of the New York public.

Bulletin 56, of the New York State Museum, contains a description of the map, an interesting history of the New York Geologic Surveys, and a detailed acknowledgment of the material contributed by geologists for the present edition.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, May 20, 1903.

To conclude the account of the Service Hydrographique de la Marine we must say something of the last four sections—that of Nautical Instructions, that of Scientific Instruments, that of Nautical Instruments, and that of Nautical Meteorology.

The Section of Nautical Instructions is charged with the publication of works intended to accompany the marine charts and to bring together all the information useful for the navigation of the coasts and for entering the channels and ports (data concerning the winds, the tides and currents, the buoyage, the pilotage, routes, resources of ports, etc.). By the help of similar documents issued by other maritime nations and selections from technical publications, the volumes of the Nautical Instructions, carefully revised to the time of publication, succeed each other as fast as possible. Side by side with these are the seven great volumes of the Lighthouse List, republished every year with the addition of carefully-registered corrections, and also the Notices to Mariners, the number of which constantly increases. Other works of this Section are the Hydrographic Annals (a collection of reports and memoirs on hydrography and navigation), the Supplements to Tables of Distances, established in 1881 and 1893; the International Code, dating from 1901; the books of Fleet Signals, etc.—all demanding the closest and the most sustained attention and toil on the part of the staff.

The Section of Scientific Instruments has devised and carried out since 1889 many improvements. It publishes, under the title of Researches on Chronometers and Nautical Instruments, papers on the use of astronomical, hydrographic, magnetic, and other scientific apparatus.

The Sixth Section, that of Nautical Instruments, introduced in 1886 a serious reform in the types adopted, beginning with the compasses and extending to the barometers, the telescopes, the micrometers, and adding the Banaré stigmograph for finding the ship's position when the compass is out of order.

The work of the Seventh Section, that of Nautical Meteorology, embraces: the digest and the publication of the meteorological records and the analysis of documents, such as log-books, meteorological registers, recorded observations, telegraphic and others, at

home and in the Colonies. This Section also examines the Four Weeks' Sheets, regularly kept on all war vessels, and epitomizes, in concert with the Central Meteorological Bureau, the contents of the registers filled out on merchant vessels according to a uniform model. It keeps monthly records of observations and publishes extracts from meteorological journals (particularly on the subject of cyclones) in the *Annales Hydrographiques*, calculations of currents, and notes on the surface temperatures of the North Pacific Ocean. These notes are intended to complete the important work on the same subject accomplished by Admiral Makaroff.

The Congress of Learned Societies held its Annual Meeting at Bordeaux, from the 16th to the 20th of April. In a study of the Currents of the Bay of Biscay, M. Bénard, President of the Oceanographical Society, reaches the conclusion that the Rennell Current does not exist, but that the current described by the Prince of Monaco and M. Hautreux enters the Bay on the north and leaves it on the southwest. M. Manley-Bendall reported progress in the preparation of the litho-biological map of the floor of this portion of the Atlantic.

M. Fabre, after an examination of the shingle, arrived at a new interpretation of various morphological peculiarities on the coast of Lower Gascony. M. Ch. Duffart, with the help of manuscript maps of Claude Masse, reconstructed the coast-line of the Landes at the beginning of the XVIII. Century, and M. Auguste Pawlowski performed a similar service for the Médoc region.

In historical geography, M. Emile Belloc read a communication on cairns and their still undetermined geographical signification, and M. l'Abbé Ricaud presented a paper on the districts included in the department of the Hautes-Pyrénées in 1790.

Dr. Giraud described the wild tribes of Upper Tonkin; M. Emile Belloc made a communication on fresh-water plankton, and M. Henri Lorin treated the Basque emigration and colonisation of French North Africa—a paper which found its complement in a note by M. Delmas on the commercial relations between Bordeaux and the western coast of Africa, exclusive of the Congo. Mention must be made of M. Marcel Charrol's studies on the anemometry of the Western Mediterranean basin and those of M. Montaudry on the meteorology of the Bay of Biscay.

Besides M. Stokes, whose address on the polar regions attracted general attention, the speakers at the meetings of the Société de Géographie have been Messrs. E. Gallois, Jean Duchesne-Fournet, A. Lacroix, and F. de Chevilly. The journey of M. Duchesne-

Fournet in Ethiopia is not to be overlooked. Starting from Jibuti, in company with Lieut. Collat, Dr. Goffin and the non-commissioned officers Fonteneau and Lahure, he passed through the desert of the Issa Somalis and the Danakil, Harar and the profound depression of the Hawash to Addis-Ababa, from which he turned to the north, reached the cañon of the Blue Nile and penetrated into Godjam. He returned to Addis-Ababa by way of Addis-Alem. The principal results obtained were a survey of Lake Tsana by theodolite, on a scale of 1 : 60,000, and the exploration of Koutaï (an outlier, so to speak, of Shoa, attached to the mountain-crest of the upper Metcha and Entotto).

M. Lacroix illustrated his report of his observations in Martinique with numerous photographs, showing the growth of the *lava dome*, shaped like a tooth or an obelisk, rising more than a thousand feet above the crater-edge of the Montagne Pelée. From the walls of the dome issue the *burning clouds*, formed by a mixture of steam, of ashes, and of blocks at a high temperature, which roll down to the sea, filling the ravines and carrying everything before them. M. Lacroix is the first savant who has studied these clouds, to which must be attributed the catastrophe of Saint Pierre. With a parallel between the eruptions of Martinique and Saint Vincent and the description of a discharge of mud from the volcano on the latter, M. Lacroix brought his address to a close. It is his opinion that, in view of the persistent activity of the Montagne Pelée and the continued production of the *burning clouds*, the principal destructive element, it will be necessary to prolong indefinitely the evacuation of the mountain slopes and the northern portion of the island, to which the ruin is confined. The rest of Martinique enjoys perfect tranquillity, and there is no reason to despair of its future.*

In Western Africa Messrs. Vasseur, Larcher, and Cardozo, of the Compagnie Française du Congo, have made interesting reconnaissances, a map of which, in the *Mouvement Géographique*, shows a part of the course of the Sanga and that of the Likuala, traced for the first time between Botungo, the farthest point reached by Captain Jobit in 1900, and Ebele, 40 to 45 minutes more to the north. M. Superville, administrator of Kotto, has explored the mountain mass which separates the Ubangi, the Bamingi, and the affluents of the Bangoran, and has made a map of his route on a scale of 1 : 250,000. The Chevalier Expedition has mapped the upper course of the Bamingi and all its eastern affluents and dis-

* M. Giraud, who accompanied M. Lacroix on his first visit to Martinique, and is now in the island, has lately expressed a similar opinion.

covered the source of most of these streams, and it brings reports of the existence of a large lake on the confines of Darfur, Dar Runga, and Wadai, called the Mamun; probably the Wadi Mamun recently mentioned on hearsay by the Russian traveller Potagos. Another lake is described as inhabited by lake-dwellers. It is in the same region that Captain Julien has continued his work of surveying the basins of the Bamingi, the Bangoran, and the Bakaré, and his reconnaissances in El Kuti and Ndele; and the members of the du Bourg de Bozas Expedition terminated their journey by surveying the course of the Welle between the confluence of the Kibali and the Dongu and Bomokandi. These gentlemen, Messrs. Brumpt, Golliez, and Didier, reached Paris on the 23d of March, and we shall learn before long the details of the work accomplished.

In Madagascar Captain Almand has made careful observations on the climate of Fianarantsoa for twenty consecutive months; and M. Paul Lemoine has studied the geology of the northern part of the island. In Asia the company charged with the construction of the railroad from Lao-kay to Yünnan-Hsien has decided to carry the road through the well-peopled valley of the northern branch of the upper Si-Kiang and by Yang-Ling.

In America Messrs. de Créqui-Montfort and Sénéchal de la Grange will make a scientific study of the Bolivian high plateaux, and this will be united with the work of Dr. Rivet, of the Geodetic Expedition in Ecuador.

Dr. Charcot's intended Arctic voyage, announced in my last letter, has been abandoned, in deference to the wishes of his patrons, and he will set out for the Antarctic. From Tierra del Fuego he will endeavour to reach Alexander I. Land, and will devote himself, in the sector comprised between 65° and 160° of longitude, to scientific researches bearing upon oceanography, geography, and zoology, and completing, in this way, the investment of the Antarctic, where the English are at work in Victoria Land, the Germans near Kemp and Enderby, the Swedes near Louis-Philippe Land and Gerlache Strait, and the Scots in the Weddell Sea. In the region of Alexander I. Land everything has yet to be discovered; and it may be hoped that Dr. Charcot's expedition will be fruitful in results. The presence of M. de Gerlache on board the *Pourquoi Pas?* is a happy augury; and if France still remains indifferent to Arctic enterprise, there is reason to rejoice that the heritage of Bouvet and Kerguélen and Dumont d'Urville is in good hands.

Among the many works of a geographical nature published in the last two months, considerable importance is to be attached to

M. Vidal de la Blache's Introduction to the History of France, issued under the direction of M. E. Lavisse. This Introduction merits a separate notice at a later day.

Something must be said of M. Lugeon's study of the Alps of Chablais and Switzerland—a study which tends to the overthrow of the accepted theories as to the formation of the Alps. According to M. Lugeon, the Alps must be regarded as deposits, transported a distance of fifty miles from the south on the inner line of the Alpine curve, in the zone of the amphibolites of Ivrea. This hypothesis is not more bold than seductive, since it enables us to group the majority of the known facts and to arrange them in an orderly succession, and marks a real advance on the theory of fan-like diverging folds.

A work by M. de Mathuisieulx, *À Travers la Tripolitaine*, is a contribution to the knowledge of a country made difficult of access by the Turkish authorities. The *Voyages au Maroc* of the Marquis de Segonzac is the record of journeys accomplished at the risk of his life, in the years 1899–1901. The book is divided into two parts: one tells the story of the author's excursions in the Rif, among the Djebala and the Braber and in the Sus; the other presents, systematically arranged by competent specialists, all the scientific information gathered, with a geographical notice by M. René de Flotte Roquevaire, the cartographical authority for this portion of North Africa and author of the excellent map, on a scale of 1:2,000,000, which accompanies the *Voyages*. There are also nine detailed maps of itineraries, on a scale of 1:250,000, and plates of sketches and profiles (separately published by Barrère). Not to be overlooked are two monographs, small, but of real value: that of M. Lacroix on the *Derkaoua*,* *Yesterday and To-Day*, and those of Dr. Huguet on the *Jews of the Mzab* and on *The Tuareg*.

In the *Renseignements Coloniaux et Documents* for May, the Comité de l'Afrique Française has finished the account of M. Thomann's journey from the Ivory Coast to the French Sudan, in 1901–1902, and gives a map of the basin of the Sassandra, on the scale of 1:500,000.

Another map of special importance is that brought out by Commandant Baratier, under the auspices of the Société de Géographie, showing, on a scale of 1:1,000,000, the route of the Marchand Expedition from the upper Ubangi to Jibuti, across the basins of the

* The Derkaoua are a religious brotherhood whose doctrines enforce abstinence from every earthly ambition and an absolute detachment from the concerns of this world.

Bahr el Ghazal and the Nile, and Ethiopia. It must be regretted that this valuable map does not give the complete line of march followed by the Bonchamp party. When are we to see the account of the journey?

I must not close without noting the appearance of Dr. E. T. Hamy's Fifth and Sixth Decades of Memoirs of American Archæology and Ethnography, published under the title of *Decades Americanæ.*

HENRI FROIDEVAUX.

ACCESSIONS TO THE LIBRARY.

MAY–JUNE, 1903.

BY PURCHASE.

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Native Navajo Dyes. *Reprint from the Papoose for February, 1903.* pr., 8vo.

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THE NEW PORT OF VERA CRUZ.

The accompanying map shows the improvements which have converted Vera Cruz into a safe harbour. Those who knew the sea front of the city a few years ago would scarcely recognize it to-day.

Vera Cruz has always been the chief port of Mexico. In the fiscal year 1900–01, 338 vessels from foreign ports entered the harbour. Their tonnage was 913,698, and they carried 355,930 metric

tons of freight. The value of the imports in that year in Mexican dollars was $22,349,788; and of the exports, $21,954,876. While doing this large business, Vera Cruz in its shipping facilities was one of the poorest ports in America. Large vessels were not able to reach the small stone pier projecting into the roadstead. Their cargoes were taken to the land by lighters. There was no protection against the storms of the Gulf. During the season of hurricanes every sailing vessel which cast anchor in front of the town did so at the peril of life and cargo. Every steamer kept up steam ready to put to sea at the first sign of dirty weather. In a single year thirteen vessels dragged their anchors and were dashed to pieces on the rocks.

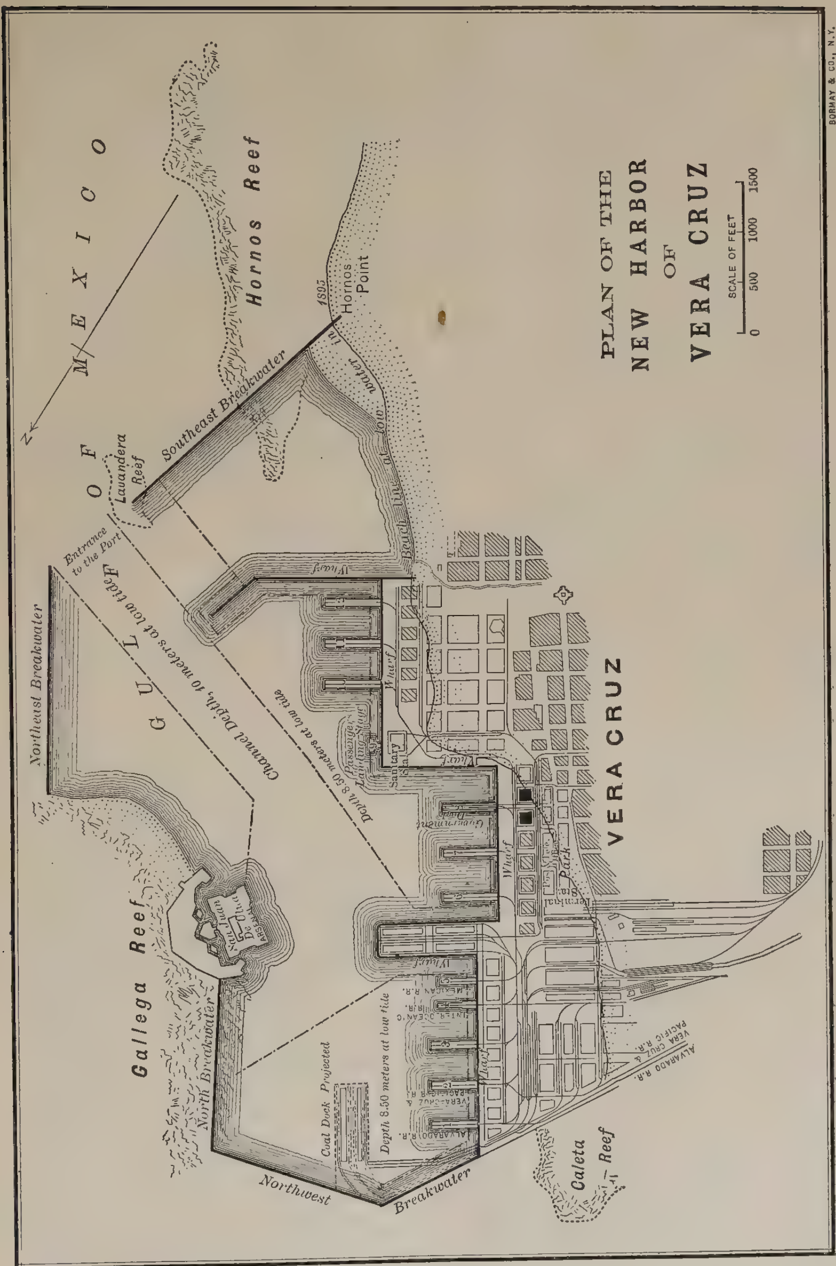
The results of these disadvantages were excessive charges for freight and insurance and continued disquietude of mind among shipowners, merchants, and sailors. All this has been changed by the conversion of Vera Cruz into a first-class artificial port, equal to any in the world, and equipped with every modern facility. The new port was opened by President Diaz on March 6, 1902.

The work cost about $30,000,000. The problem was to convert the open roadstead into a protected harbour by means of artificial defenses combined with natural features. The natural features were the coral reefs partly encircling the bay, which previously had been chiefly a danger, but were now made to subserve the plan for the protection of the harbour.

The reefs were, on the north, La Caleta, near the shore, and La Gallega, 600 metres out in the Gulf; and on the south the Hornos, near the shore, and the Lavandera, about 320 metres out. The Gallega reef is the most extensive, stretching opposite the city for a distance of 1,200 metres. These reefs form a sort of bay, 2,000 metres wide. The bay was completely exposed to the north and northeast winds. When a heavy norther blew, the waters of the Gulf were driven with great violence through the narrow passage between the Caleta and Gallega reefs. Any plan for improving the port involved the closing up of the north entrance to the harbour between these two reefs. This and much more was done, as is shown in the following enumeration of the exterior protective works:

1. The northwest breakwater, extending from the Caleta reef across the bay to the Gallega reef, closing the old north entrance to the port and affording the chief protection against the north wind.

2. The north wall (previously built) joining the foregoing with the Island of Ulua.


PLAN OF THE
NEW HARBOR
OF
VERA CRUZ
SCALE OF FEET
0 500 1000 1500
GULF OF MEXICO
N
Hornos Reef
Hornos Point
1895
Southeast Breakwater
Lavandera Reef
Entrance to the Port
Northeast Breakwater
Channel Depth, 10 meters at low tide
Depth 8.50 meters at low tide
Beach line at low water
Wharf
Passenger Landing Shed
Sanitary Sta.
Government Docks
Gallega Reef
San Juan De Ulua
ARSENAL
North Breakwater
Northwest Breakwater
Coal Dock Projected
Depth 8.50 meters at low tide
MEXICAN R.R.
INTER-OCEANIC R.R.
VERA-CRUZ & PACIFIC R.R.
ALVARADO R.R.
VERA CRUZ & PACIFIC R.R.
ALVARADO R.R.
Terminal Sta.
Park
VERA CRUZ
Caleta Reef
BORMAY & CO., N.Y.

3. The northeast breakwater, extending from the Gallega reef to the entrance of the harbour.

4. The southeast breakwater, protecting the harbour on the south, extending from the Hornos reef to the Lavandera reef, and leaving between its outer extremity and the outer extremity of the northeast breakwater a channel 260 metres wide, forming the entrance to the harbour. Both extremities are provided with lighthouses.

5. As a further measure of defense against the prevailing south wind an inner protective wall, forming part of the town quay, was built about a kilometre inside of the southeast breakwater, the space between them being reserved for anchorage.

The town quay was built in the sea, at a distance of about 400 metres from the low-water line. The space between it and the land was filled with sand, and buildings are rising on the land thus reclaimed from the sea. The piers for shipping, as is shown on the map, were extended at right angles from the town quay. One is the fiscal pier, where the Customs business of the port is transacted. Some of the other piers are occupied by the railroads, freight being transferred directly between the cars and the vessels tied up at the piers. Two spacious warehouses have been completed, and sites have been reserved for an indefinite number of others. Thus, to the shipping interests of Vera Cruz greater wharfage and storage facilities are assured.

These improvements, however, were not all that was needed to enable the city to enjoy the prosperity to which its commercial preeminence entitles it. It is imperatively necessary to improve the health of the city. It is almost fatal to a large port if ships leaving it are persistently quarantined upon their arrival at foreign ports. The city had no good sewage system, and its water was not fit to drink. To this fact was largely due the terrible yellow fever which gave the city such an evil reputation. For the past year new sewerage and water-supply works have been rapidly advancing. These works are of the best and most thorough kind. Pure drinking water will be obtained by pumping works from the Jamapa River, and will afford an ample supply for twice the present population of Vera Cruz. The improved sewerage system is far advanced, and will have a total length of about 55 kilometres. It is expected that the transformation of Vera Cruz into a safe, commodious, and healthful port will stimulate the trade relations of Mexico with foreign countries, increase business, and add to the wealth of the Republic.

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JUNE 30, 1903.

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1902 Acheson, Edward G.
1902 Ackerman, Ernest R.
1892 Adams, Cyrus C.
1903 *Adams, Edward D.*
1899 Adams, Robert Franklin.
1891 Agar, John G.
1885 Agnew, Andrew G.
1886 Alden, R. Percy.
1898 *Aldrich, Mrs. James Herman.*
1898 Alexander, Harry, E.E., M.E.
1888 Alexander, J. F.
1901 Allen, James Lane.
1898 Allen, W. F.
1898 *Allin, F. Brevoort.*
1899 Alvord, Andrew Porter.
1883 Ames, Adelbert.
1903 Amundson, John A.
1890 *Anderson, Arthur A.*
1897 Anderson, A. J. C.
1901 Anderson, R. Napier.
1890 Andreini, J. M.
1887 Andrews, Wm. L.
1898 Appleton, Herbert.
1887 *Archbold, John D.*
1891 Arms, George.
1898 Armstrong, Charles P.
1891 Armstrong, Collin.
1899 Arnold, Benjamin Walworth.
1895 Arnot, M. H.
1890 Astor, John J.
1874 *Astor, William W.*
1891 Atkinson, John B.
1883 *Atterbury, J. T.*
1903 Atwater, James C.
1899 Atwood, Kimball C.
1874 *Avery, Samuel P.*
1899 *Aycrigg, B. Arthur.*
1897 Ayer, James C., M.D.

Date of Election.

1874 *Backus, Henry C.*
1886 Backus, J. Bayard.
1882 *Bacon, Francis M.*
1897 Bacon, Selden.
1897 *Bailey, Miss Alletta Nathalie.*
1898 Bailey, James H.
1902 *Baker, B. N.*
1902 Baker, Charles W.
1902 Baker, John Carleton.
1899 Baker, O. M.
1898 Balch, Berkeley.
1900 *Balch, Edwin S.*
1881 *Baldwin, Edwin.*
1882 Baldwin, Octavius D.
1874 *Baldwin, Townsend B.*
1899 Baldwin, William D.
1901 *Ballantine, Robert F.*
1888 *Bancroft, H. H.*
1884 Bangs, Fletcher H.
1868 *Banks, David.*
1880 *Banks, D. S.*
1869 Banyer, Goldsboro.
1891 Barber, Amzi L.
1887 *Barbey, Henry I.*
1882 *Barger, Samuel F.*
1889 Baring, Thomas.
1886 *Barker, P. C., M.D.*
1890 Barnard, John F.
1901 Barnard, John H.
1898 Barnes, Chas. J.
1874 Barnes, John S.
1882 Barney, N. C.
1902 Barr, Edward.
1874 Barr, William.
1887 *Barron, John C., M.D.*
1888 Barstow, J. Whitney, M.D.
1878 *Barton, Oliver Grant.*
1899 *Bartow, Charles S.*
1898 Batchelor, Charles.
1903 Batchelor, Joseph C.

Date of Election.

1899 Beach, Rev. Harlan P.
1895 Beal, William R.
1901 Beckley, John N.
1886 Beddall, Edward F.
1875 Beekman, Gerard.
1888 Beers, M. H.
1874 Belding, Milo M., Sr.
1897 Belding, Milo M., Jr.
1891 Belin, Henry, Jr.
1901 Belknap, Henry.
1900 Bell, Alexander Graham.
1900 *Bell, Bertrand F.*
1897 Bell, Dr. Ralcy H.
1883 Bell, Capt. William R.
1890 Benedict, James H.
1897 Benjamin, Morris W.
1868 Bennett, James Gordon.
1883 Benson, Frank Sherman.
1890 Bergen, James C.
1891 Bernheim, Gustav.
1903 Bernheimer, Charles L.
1890 Bertschmann, J.
1886 Berwind, Edward J.
1891 Besly, Chas. Howard.
1875 Beste, Henry.
1869 Bickmore, Prof. A. S.
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1889 Biddle, Edward R.
1895 Bien, Joseph R.
1874 Bien, Julius.
1903 Bigelow, Frank G.
1889 *Bigelow, Poultney.*
1887 *Biglow, Lucius H.*
1891 Bogue, Virgil G.
1903 Binney, Harold.
1897 Billings, Frederick.
1893 Birdsall, Mrs. W. R.
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1898 Blake, Theodore A.
1900 Blinn, F. Gray, M.D.
1878 *Bliss, Cornelius N.*
1890 *Bliss, D. L.*
1901 Bliss, William H.
1897 Blodgett, Mrs. William T.
1895 Boas, Emil L.
1888 Bogert, S. G.
1891 Boies, H. M.
1886 Bond, Frank S.
1884 *Bonner, G. T.*
1874 Bookstaver, Henry W.

Date of Election.

1899 Booraem, John V. V.
1859 *Boorman, J. Marcus.*
1897 Booth-Tucker, Frederick de L.
1900 Bormay, W. J.
1899 Botsford, Elmer F.
1901 Bouker, Le Grand.
1903 Bourne, Charles Griswold.
1886 Bouvier, M. C.
1902 *Bowditch, Charles P.*
1900 *Bowdoin, George S.*
1886 Bowers, John M.
1883 *Bowne, Walter.*
1890 *Boyd, John Scott.*
1890 *Brackenridge, George W.*
1897 Bradley, Charles W.
1895 Bradley, Edson.
1897 *Brainard, Lt.-Col. David L., U. S. A.*
1899 Brett, George P.,
1890 Brewster, C. O.
1902 *Brewster, Robert S.*
1886 Bridgman, E. C.
1900 Bridgman, Herbert L.
1903 Brizse, Charles N.
1889 *Bromberg, Frederick G.*
1902 Brooke, Charles F.
1890 Brooker, Chas. F.
1897 Brooks, George G.
1886 *Brown, Addison.*
1901 Brown, Alexander, Jr.
1903 Brown, Benjamin D.
1903 Brown, F. Q.
1878 Brown, J. Romaine.
1878 Brown, Rev. Philip A. H.
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1899 Browne, Aldis B.
1875 Brownell, Silas B.
1874 *Brownson, Commander W. H., U. S. N.*
1901 *Bruce, Miss Matilda W.*
1901 *Bruce-Brown, William.*
1901 Bruguière, Louis Sather.
1902 *Buchanan, James Isaac.*
1900 Bulkley, Justus L.
1903 *Bunker, George R.*
1897 Burdge, Franklin.
1898 Burr, William H.
1902 *Burrage, Albert C.*
1902 *Burrage, Albert C., Jr.*
1902 *Burrage, Francis H.*

Date of Election.
1902 *Burrage, Russell.*
1903 Burton, Prof. A. E.
1899 Busby, Leonard J.
1890 Bushnell, Joseph.
1902 Butes, Alfred.
1895 Butler, Joseph G., Jr.

1888 Canda, Charles J.
1887 Cannon, H. W.
1884 Carey, Henry T.
1894 Carey, William Francis.
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1898 Carmalt, Dr. W. H.
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1889 *Carter, John J.*
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1897 Chamberlain, Rev. John.
1897 Chamberlain, Rev. Leander T.
1899 Chambers, Arthur D.
1897 Chambers, Frank R.
1899 Chambers, Frederick F.
1890 Chanler, William Astor.
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1901 Chapin, E. P.
1883 *Chapman, Henry E.*
1868 Chapman, Joseph H.
1888 Chase, George.
1901 Chase, Dr. Walter G.
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1891 Clapp, George H.
1889 Clark, Charles F.
1887 Clark, Jefferson.
1901 Clark, W. A.
1886 Clarke, C. C.
1882 *Clarkson, Banyer.*
1889 Clausen, George C.
1883 Clews, Henry.
1883 Clyde, William P.
1890 Cockcroft, Miss Mary T.
1897 Coffin, C. A.

Date of Election.
1886 Coffin, Edmund.
1891 Cogswell, W. B.
1891 Cohen, Samuel M.
1900 Cole, Edward H.
1901 Cole, George Watson.
1888 Coleman, James S.
1888 Colgate, Abner W.
1874 Colgate, James B.
1898 Collier, M. Dwight.
1893 *Colvin, Verplanck.*
1897 Combe, Mrs. William.
1892 Comer, John H.
1897 *Comstock, Frederick H.*
1889 Comstock, George Carlton.
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1884 *Connor, W. E.*
1874 *Conyngham, William L.*
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1894 Cook, Dr. Frederick A.
1888 Cook, Henry H.
1893 Coolidge, J. Randolph.
1856 Cooper, Edward.
1903 Cornell, Russell R.
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1897 Corning, G. M.
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1902 Cotton, Louis K.
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1898 Cox, A. Beekman.
1899 *Cox, John Lyman.*
1902 *Coxe, Eckley B., Jr.*
1889 *Coxe, Henry B.*
1901 *Crain, Dunham Jones.*
1902 Cramp, Charles H.
1889 *Crane, Charles R.*
1902 *Crane, Zenas.*
1887 *Cranitch, William I. A.*
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1888 Crimmins, John D.
1899 Crimmins, T. E.
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1874 Crosby, J. Schuyler.
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1903 Cumnock, Victor I.
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1898 Curtis, Osborn Marcus.

Date of Election.
1901 *Curtis, William Edmond.*

1889 Daley, George H.
1884 Dalley, Henry.
1871 Daly, Joseph F.
1901 Dana, Samuel B.
1903 Dana, William B.
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1892 Daniels, W. L.
1888 *Davenport, Ira.*
1898 Davidson, James W.
1875 Davies, Julien T.
1884 Davis, Howland.
1877 *Davis, Joseph Beale.*
1901 Dawson, Miles Menander.
1880 *Deane, John H.*
1892 DeBuys, A.
1883 Decker, Joseph S.
1901 de Coppet, Henry.
1880 *Deen, William M.*
1895 De Kalb, Courtenay.
1900 *Delafield, Albert.*
1874 Delafield, M. L.
1886 *de Lancey, Edward F.*
1897 Delbridge, Charles L.
1903 de Lemos, Theodore W. E.
1890 Dellinger, Charles F.
1901 Dennis, Rev. James S.
1899 Dennis, John B.
1899 Dennis, Rodney S.
1901 Dennis, Samuel S.
1875 *de Peyster, Frederic J.*
1874 *de Peyster, Gen. J. Watts.*
1880 *Dexter, Henry.*
1894 Dieterich, Charles F.
1897 Dillingham, Edwin R.
1890 *Dinsmore, C. Gray.*
1899 Diven, George M.
1886 Dix, Morgan, D.D.
1881 *Docharty, Augustus T.*
1889 Dodd, S. C. T.
1897 Dodge, Rev. D. Stuart.
1903 Dodge, Gen. Grenville M.
1896 Dodge, Richard E.
1901 Dodge, Walter Phelps.
1856 Dodge, William E.
1893 Dodson, Robert Bowman.
1875 Dommerich, L. F.
1889 *Donald, Peter.*
1903 Donovan, John J.

Date of Election.
1899 Doremus, Robert P.
1897 Doughty, Mrs. Alla.
1884 *Douglas, James.*
1903 Douglass, R. D.
1888 *Drexel, Mrs. Joseph W.*
1891 Drey, Max.
1880 Du Bois, Frederick W.
1874 *Du Bois, William A.*
1898 Dunham, Edward K., M.D.
1897 Dunnell, William N., D.D.
1897 Dunscomb, S. Whitney, Jr.
1889 Du Pont, Col. H. A.
1885 *Dupré, Ovide.*
1901 *Durand, John S.*
1889 Durkee, Eugene W.
1894 Duvall, William C.
1889 Dwight, Jonathan, Jr., M.D.

1882 *Earle, Joseph P.*
1886 *Easton, Robert T. B.*
1902 Eberstadt, Edward F.
1880 Eckert, Gen. Thomas T.
1882 Edwards, J. Pierrepont.
1887 Egleston, Melville.
1897 Eimer, August.
1901 *Eldert, Cornelius.*
1901 *Eldridge, Lewis A.*
1900 Eldridge, Roswell.
1887 Elkins, S. B.
1879 *Elliott, Samuel.*
1886 Ellis, George W.
1875 Ellis, John W.
1882 *Ellis, Wilbur Dixon.*
1903 Ellis, William H.
1897 Ellison, John E.
1900 Embury, Aymar.
1882 *Emerson, John W.*
1868 Emmet, Thomas Addis, M.D.
1903 Endicott, William C.
1883 Eno, Amos F.
1903 Eskeson, Eckhardt V.
1891 Eustis, W. E. C.
1891 Eyerman, John.

1901 Fahys, George E.
1882 Fairbanks, Leland.
1890 Fairchild, Chas. S.
1892 Fairchild, Samuel W.
1902 Fairleigh, David W.
1875 Fargo, James C.

Date of Election.
1901 *Farnsworth, William.*
1896 Farquhar, Edward Y.
1874 Farragut, Loyall.
1903 Faulkner, Charles J.
1901 Faust, John Armstrong.
1890 *Fearing, Daniel B.*
1898 Fearons, Geo. H.
1898 *Ferguson, Henry.*
1888 *Ferguson, Walton.*
1900 Fischer, Emil S.
1901 Fischer-Hansen, Carl.
1902 Fisk, Harvey Edward.
1902 Fisk, Pliny.
1903 Fitzgerald, Frank T.
1886 *Flagler, H. M.*
1871 Fliess, Wm. M.
1889 Flint, Chas. R.
1901 *Flower, Anson R.*
1901 *Flower, Frederick S.*
1875 Folsom, George W.
1875 *Ford, James B.*
1901 Fowler, Jonathan Odell, Jr.
1894 Fox, Andrew Jackson, M.D.
1874 *Fox, Austen G.*
1884 Frazer, Alfred.
1894 Frazer, Horatio N.
1873 Freedman, John J.
1889 Freeland, Theodore H.
1894 Frick, John.
1902 Frissel, A. S.
1875 Fuller, Charles D.
1901 Fulton, E. M., Jr.

1898 Gadd, Luther G.
1903 *Gaff, Thomas T.*
1889 *Gage, E. B.*
1886 Gallatin, Frederic.
1897 Garver, John A.
1903 *Gates, Isaac E.*
1891 Gay, Edward.
1879 Gay, Joseph E.
1868 *Gebhard, William H.*
1903 Gerdau, Otto.
1900 Gerhard, William Paul, C.E.
1868 *Gerry, Elbridge T.*
1889 *Gest, Erasmus.*
1894 Gherardi, Bancroft, Rear Adm. U. S. N.
1897 Gibbs, Frederick S.
1894 Gibbs, John Wilson, M.D.

Date of Election.
1874 *Gibbs, Theodore K.*
1903 Gibney, John R.
1899 Gibney, Dr. V. P.
1901 *Gilbert, Clinton.*
1889 Gilbert, G. K.
1893 *Gilbert, J. H. Grenville.*
1903 Gilman, Theodore P.
1885 Glazier, Simon W.
1897 Gleason, John J.
1897 Golding, John Noble.
1903 Goldman, Albert.
1898 *Goodnow, Harold P.*
1900 Goodridge, F. G., M.D.
1898 Goodwin, Rev. Francis.
1886 *Goodwin, James J.*
1887 Gossler, Gustav H.
1887 Gould, George J.
1881 *Grace, William R.*
1899 Grant, F. E.
1879 *Graves, Arthur B.*
1895 Greeff, Ernest F.
1868 Green, Andrew H.
1897 Green, Frederick V.
1901 Green, Pinckney F.
1898 Green, Samuel Swett.
1891 Greene, David M.
1898 Greene, Jacob L.
1883 *Greenough, John.*
1892 Greenwood, Langdon, Jr.
1897 Grossmann, Ignatius R.
1887 *Grosvenor, James B. M.*
1897 Gruber, Abraham.
1897 Gunther, Charles B.
1886 *Gunther, Franklin L.*
1891 Haas, Kalman.
1869 *Hadden, John A.*
1897 Hagerman, G. E.
1887 Hague, James D.
1874 *Haines, John P.*
1901 Hall, Rev. Dr. Charles Cuthbert.
1868 Hall, Elial F.
1903 Hamilton, Edmond H.
1879 Hamilton, William Gaston.
1901 Hand, Learned.
1888 Harbeck, Charles T.
1888 Hard, Anson W.
1901 Hardie, Wainwright.
1900 Harding, Edward.
1900 Hardley, J. Wheeler.
1902 Hare, J. Knowles.

Date of Election.
1903 Harrison, Hugh H.
1897 Hart, Walter T.
1903 Harvey, Miss Rebecca.
1882 Hascall, Theodore F.
1887 Hastings, Thomas S., D.D.
1889 Hastings, W.
1859 *Havemeyer, John C.*
1902 *Havemeyer, William F.*
1894 Haven, J. Woodward.
1887 Hayes, Richard Somers.
1889 Haynes, Henry W.
1891 Hazard, Frederick R.
1898 *Hearn, Arthur H.*
1897 *Hearn, George A.*
1883 *Hebert, Henry B.*
1902 Hedge, Frederic H.
1897 Heike, C. R.
1903 Heimann, Julius.
1897 Heinsheimer, L. A.
1902 Henderson, Charles R.
1886 Henderson, Harold G.
1874 Hendricks, Edmund.
1901 Hentz, Henry.
1899 *Herbert, John W.*
1891 Herrman, Abraham.
1903 Herrmann, George.
1903 Herrmann, Nathan.
1900 Herzog, F. Benedict, Ph.D.
1903 *Hewitt, Peter Cooper.*
1900 Hewlett, Walter Jones.
1901 Heydt, Herman A.
1882 *Higginson, James J.*
1894 Hildreth, J. Homer.
1903 Hill, Charles B.
1890 Hill, James J.
1886 Hillhouse, Thomas G.
1887 Hinchman, Walter.
1899 Hinkley, James W.
1881 Hinman, Russell.
1878 Hinman, William K.
1874 *Hinton, John H., M.D.*
1903 *Hirsch, Robert B.*
1889 *Hitchcock, Welcome G.*
1903 Hobbs, Edward H.
1903 Hodgman, George F.
1898 Hodgson, Richard, LL.D.
1886 Hoe, Robert.
1897 Hoe, William A.
1876 Hoes, William M.
1897 Hoey, Rev. Joseph L.

Date of Election.
1901 Hoffman, Charles F., Jr.
1872 *Holbrook, Levi.*
1893 Holls, Frederick William.
1898 Holmes, George.
1876 Holt, Henry.
1902 Holton, Henry D.
1901 *Hopkins, George B.*
1896 Hoppin, Hamilton L.
1898 Hoppin, James M., D.D.
1897 Hoppin, Samuel Howland.
1896 Hotchkiss, Miss C. W.
1898 Howell, M. D.
1888 *Hoyt, Henry R.*
1898 *Hubbard, Robert J.*
1901 *Hubbard, Thomas H.*
1885 Hubbard, Walter.
1900 Hudnut, Richard A.
1897 Humphreys, Alexander C., C.E.
1903 Humphreys, Edward W.
1887 Hunker, J. J., Com'd'r U. S. N.
1893 *Huntington, Archer M.*
1868 *Huntington, Daniel.*
1893 Hurlbut, Theodore D.
1898 Hurley, Thomas J.
1883 *Hurry, Edmund Abdy.*
1889 *Hurtt, Frank D.*
1890 Husted, Seymour L., Jr.
1895 *Hutchinson, Charles Hare.*
1897 Huyler, John S.
1901 Hyde, Augustus L.
1892 *Hyde, Clarence M.*
1883 Hyde, E. Francis.
1897 Hyde, Dr. Frederick E.
1901 *Hyde, James H.*

1899 Insull, Samuel.
1899 Ireland, J. de Courcy.
1859 Ireland, John B.
1890 Irving, Walter.
1874 Iselin, Adrian, Jr.
1887 *Isham, Charles.*
1881 *Ives, Brayton.*
1903 *Ives, Frederick D.*

1903 Jackson, A. Wendell.
1886 *Jackson, Rev. Samuel M.*
1897 Jackson, Theodore F.
1886 Jacobi, Abraham, M.D.
1902 Jacobs, Henry Barton, M.D.
1891 Jaffray, Robert, Jr.

Date of Election.
1894 James, Arthur Curtiss.
1874 James, D. Willis.
1890 James, Walter B., M.D.
1886 Janeway, Henry L.
1890 Janin, Henry.
1891 Jaques, W. H.
1903 Jarvie, James N.
1879 Jay, William.
1887 Jenkins, Augustus S.
1893 Jenkins, Michael.
1874 Jenkins, William L.
1903 Jennings, Abraham Gould.
1895 Jennings, Oliver G.
1902 Jessup, Henry W.
1874 *Jesup, Morris K.*
1880 *Jewett, George L.*
1881 Johnson, Bradish.
1901 Johnson, Edward C.
1893 Johnson, Reverdy.
1888 *Jones, Oliver L.*
1871 Jones, Walter R. T.
1891 Jones, Washington.
1897 Judson, Rev. Edward.
1885 Juilliard, A. D.
1901 Julian-James, Mrs. Cassie.

1898 Kahn, O. H.
1881 *Kane, Grenville.*
1893 *Kane, Henry Brevoort.*
1879 Kane, S. Nicholson.
1895 *Kean, Hamilton F.*
1874 Keck, Thomas.
1880 *Keene, James R.*
1888 Kellogg, Charles.
1897 Kemmerer, M. S.
1903 Kemp, James Furman.
1873 *Kennan, George.*
1901 Kennedy, E. G.
1901 *Kennedy, George G., M.D.*
1888 Kennedy, H. Van Rensselaer.
1881 *Kennedy, John S.*
1901 Kent, William.
1885 *Keppler, Rudolph.*
1878 *Kernochan, James Lorillard.*
1903 Kerr, John B.
1883 Kerr, Walter.
1901 *Ketchum, Alexander P.*
1887 Kevan, William.
1886 *Kidder, Camillus G.*
1901 Kidder, James H.

Date of Election.
1897 Kimball, Alfred R.
1889 *Kimball, F. J.*
1883 King, D. H., Jr.
1874 King, Edward.
1902 *King, Mrs. Edward.*
1882 *King, George Gordon.*
1892 King, John Hurtin.
1874 *Kingsland, William M.*
1901 Kirby, Thomas E.
1881 Kirsch, Louis.
1888 Kissel, Gustav E.
1891 Kissel, Rudolph H.
1899 Knight, D. Allen.
1887 *Knight, George T.*
1901 Kohlman, Charles.
1897 Kohn, S. H.
1901 Kohnstamm, Emil V.

1890 Lamberton, Charles L.
1895 Landon, Francis G.
1898 Lane, Wolcott G.
1882 Langdon, Woodbury.
1881 *Langdon, Woodbury G.*
1882 Lapham, Lewis H.
1897 Larrabee, Jesse.
1859 *Lathers, Richard.*
1902 Laughlin, Harry H.
1901 Lawrence, Arthur, D.D.
1897 Lawrence, Cyrus J.
1892 Lawrence, E. A.
1902 Lawrence, John Burling.
1903 Lawson, Victor F.
1901 Lawson, William.
1893 Learned, William L.
1886 Leete, C. H.
1900 Le Gendre, William C.
1900 *Leggett, Francis H.*
1903 Lehmaier, James M.
1903 Lesher, Arthur L.
1901 *Leupp, William H.*
1902 Leverich, S. Duncan.
1891 Levine, Julius.
1896 *Lewis, Clarence McK.*
1902 Lewis, Rev. William G. W.
1881 *Libbey, Prof. William.*
1903 Lincoln, Lowell.
1898 Lincoln, Solomon.
1902 Linderman, Garrett B.
1899 *Lippincott, Henry H.*
1903 Lisman, Frederick J.

Date of Election.
1881 *Little, Joseph J.*
1897 *Livingston, Goodhue.*
1897 Lobenstine, William C.
1901 Lockman, Myron A.
1902 Lockwood, Hanford N.
1900 Loeb, Morris.
1870 *Loew, Frederick W.*
1891 Loewy, Benno.
1887 Logan, Walter S.
1897 Long, Thomas J.
1901 Lord, Austin W.
1903 *Lorillard, Pierre.*
1890 *Loth, Joseph.*
1878 *Loubat, J. F., LL.D.*
1883 Lounsbery, R. P.
1876 *Low, A. Augustus.*
1875 *Low, Seth, LL.D.*
1903 Low, William G.
1898 Lowenstein, B.
1886 *Ludington, Charles H.*
1899 Luttgen, Walther.
1889 Lydig, David.
1900 Lyman, Frank.
1888 *Lynch, James D.*

1900 M'Caleb, Thomas.
1898 McAlan, John.
1903 McConnell, Samuel P.
1895 *McCord, William H.*
1902 McCormac, G. J.
1887 McCready, N. L.
1897 McDonald, John E.
1903 McDougall, Walter.
1901 McFarlane, C. T.
1902 McGraw, F. S.
1897 McKeen, James.
1888 McKeever, J. Lawrence.
1898 McLean, Donald.
1895 McMillin, Emerson.
1903 McWilliams, Daniel W.
1903 Maas, Gustavus.
1896 MacCoun, Townsend.
1887 Mack, J. W.
1903 *Mackay, Clarence H.*
1883 *Mackay, Donald.*
1884 *MacKellar, William.*
1890 Mackey, Charles W.
1898 MacKie, Charles Paul.
1898 MacKie, James Steuart.
1901 Macy, George H.

Date of Election.
1901 *Macy, V. Everit.*
1898 Magerhans, Adolph W.
1899 Mahl, William.
1889 *Maitland, Alexander.*
1887 Malcolm, William L.
1902 Mandeville, H. C.
1903 Mann, William D'Alton.
1874 Marble, Manton.
1897 Marc, Theophilus M.
1875 Marcus, Arnold.
1895 Marcus, George E.
1882 *Markoe, Francis H., M.D.*
1888 *Marquand, Henry.*
1898 Marsh, Joseph A.
1901 Marshall, Charles H.
1897 *Marshall, Louis.*
1898 Marston, Edwin S.
1875 *Martin, Bradley.*
1888 *Martin, Oswald J.*
1889 Martin, Robert C.
1888 *Mason, Alexander T.*
1901 Mather, Samuel.
1901 Matthews, Albert.
1899 Matthews, George E.
1902 Matthews, M. A., D.D.
1903 Maxwell, Francis Taylor.
1901 Maxwell, Robert.
1901 Maxwell, William H.
1891 Meeks, Edwin B.
1902 *Mellen, Charles S.*
1903 Mellon, Charles H.
1874 *Merrall, William J.*
1897 Merrill, William F.
1901 Meyer, Harry H.
1897 Millar, George W.
1901 *Miller, Dr. George N.*
1892 Miller, Warner.
1892 *Mills, A. G.*
1880 *Mills, Darius O.*
1875 Mitchell, Edward.
1899 Mitchell, John Murray.
1876 Mitchell, W. Howard.
1902 Monks, John, Jr.
1890 Montant, Alphonse.
1901 Montgomery, F. Warren,
1901 Montgomery, Harry E.
1859 *Moore, Frank.*
1884 *Moore, Joseph, Jr.*
1863 *Moore, W. H. H.*
1883 Morgan, E. D.

Date of Election.
1874 *Morgan, J. Pierpont.*
1901 *Morgan, J. P., Jr.*
1887 *Morgan, William Fellowes.*
1889 Morgan, William H.
1885 *Morison, George S.*
1859 *Morrell, W. H.*
1900 Morris, Fordham.
1874 *Morris, Henry Lewis.*
1903 Morris, John.
1898 *Morris, Newbold.*
1897 Morris, Robert T., M.D.
1902 *Mortimer, Rev. Dr. Alfred G.*
1864 *Morton, Levi P.*
1900 Moses, Theodore W.
1898 Moss, Charles H.
1888 Moss, Mrs. J. Osborne.
1897 Muller, Edward M.
1897 Murray, David.
1888 Myers, Theodore W.
1901 Myers, Mrs. Theodorus Bailey.

1895 Nason, Carleton W.
1901 Neeser, John G.
1886 *Neftel, William B., M.D.*
1893 Nelson, E. B.
1880 Nelson, William.
1891 Neukirch, Chas.
1897 Nevers, George G.
1899 Newbold, Clement Buckley.
1897 *Newell, F. H.*
1891 *Newman, Mrs. Angeline Ensign.*
1899 Newton, James S.
1902 Nichols, Francis H.
1897 Nichols, George L.
1892 Nichols, O. F.
1902 Nicolas, Louis J.
1899 Nimmo, Joseph, Jr.
1897 Nixon, Lewis.
1897 Notman, George.
1886 Notman, John.
1902 Noyes, Daniel Rogers.
1889 Nunn, R. J., M.D.

1888 *Oakes, T. F.*
1898 Obermeyer, Joseph.
1879 *O'Brien, Thomas S.*
1903 O'Connor, Harry L.
1901 O'Connor, Nicholas R.
1875 *O'Connor, Thomas H.*
1903 O'Donohue, Joseph J., Jr.

Date of Election.
1887 *Ogden, William B.*
1879 O'Gorman, Richard.
1897 Ohman, August R.
1901 O'Leary, H. A.
1874 Olyphant, Robert M.
1875 *Opdyke, William S.*
1893 Operti, Albert.
1882 Oppenheim, Edward L.
1889 Orr, Alexander E.
1901 *Orvis, Charles E.*
1903 Osborn, Eugene E.
1901 Outerbridge, Paul.
1903 Overstreet, William I.
1896 Owen, James, C.E.
1895 *Owen, Miss Luella A.*

1898 *Paget, Almeric H.*
1901 Paige, Edward Winslow.
1897 Palmer, N. F.
1889 Palmer, Stephen S.
1899 *Parish, Edward C.*
1872 *Parish, Henry.*
1902 Parker, James H.
1886 Parris, Edward L.
1882 *Parrish, James C.*
1882 Parsons, Charles.
1882 *Parsons, Mrs. Edwin.*
1901 *Parsons, F. A.*
1897 *Parsons, George.*
1882 Parsons, John E.
1887 Parsons, William H.
1902 Paton, David.
1897 *Paton, William Agnew.*
1903 Patterson, Charles Brodie.
1901 Paulding, Gouverneur, II.
1895 Pease, Walter A.
1901 Pech, Dr. James.
1889 Peck, Charles E.
1898 *Pell, Frederick A.*
1901 Pell, Stephen H. P.
1874 Penfold, William Hall.
1898 Pennington, William.
1902 Penwarden, Charles S.
1903 Pepper, C. H.
1887 Perdicaris, Ion.
1890 *Perkins, W. H.*
1894 Perry, John G., M.D.
1901 Perry, Dr. Safford Goodwin.
1888 Perry, William A.
1891 Peters, Edward McClure.

Date of Election.
1887 Peters, Samuel T.
1903 *Peters, William Richmond.*
1903 *Pfizer, Charles.*
1901 *Phelps, John J.*
1888 Phillips, William D.
1902 *Phipps, Lawrence C.*
1887 *Phoenix, Lloyd.*
1886 *Phoenix, Phillips.*
1889 *Pickering, Edward C.*
1895 Pickhardt, Carl.
1902 Pierce, Henry Clay.
1893 Pinchot, Gifford.
1880 Pinchot, James W.
1891 Pincus, Frederick S.
1898 Piorkowski, Capt. A. E.
1903 Pitkin, Albert J.
1885 *Planten, John R.*
1893 *Platt, J. D.*
1882 Platt, Thomas C.
1876 Plum, James R.
1890 *Plumb, Edward L.*
1884 *Plush, Dr. Samuel M.*
1903 Poggenburg, Henry F.
1852 *Poor, Henry V.*
1890 Poor, Henry W.
1891 *Porter, Henry Kirke.*
1903 Porter, Russell W.
1897 Porter, William H.
1884 Post, George B.
1885 *Post, William Henry.*
1891 Pott, James.
1890 Potter, Edward Clarkson.
1898 Potter, Frederick.
1901 *Potts, Jesse W.*
1903 *Potts, Thomas.*
1891 Powel, De Veaux.
1880 Powell, Wilson M.
1899 Pratt, Wallace.
1897 Pray, Joseph M.
1903 Prentice, Augustus.
1897 Prentiss, George Lewis.
1901 Prince, J. Dyneley.
1903 Proctor, George H.
1903 Proudfit, Frank F.
1898 Pruyn, John V. L.
1886 Pryer, Charles.
1901 Purdy, J. Harsen.
1889 Putnam, George L.
1897 Putnam, Samuel.
1903 *Pyle, James Tolman.*

Date of Election.
1894 *Pyne, M. Taylor.*
1898 *Pyne, Percy R.*

1898 Quincy, Miss Mary Perkins.
1883 Quinlin, Leonard G.

1903 *Randolph, Evan.*
1882 Rathborne, Charles L.
1868 *Raven, Anton A.*
1903 *Raven, Richard M.*
1898 Rawson, Edward Stephen.
1890 Raymond, Charles H.
1886 *Raymond, R. W.*
1902 Rea, Samuel.
1901 *Rea, Thomas B.*
1903 Read, Frank B.
1902 *Ream, Norman B.*
1898 Redding, Joseph D.
1903 Reed, Charles.
1889 *Reed, J. Van D.*
1874 Reid, Whitelaw.
1901 Reiff, Josiah C.
1897 Reinhart, Joseph W.
1899 Remington, Joseph P., Ph.M.
1903 Reno, Jesse W.
1888 Renwick, Edward S.
1874 *Reynes, Jaime.*
1898 Reynolds, J. B.
1903 *Reynolds, James B.*
1882 Rhinelander, Charles E.
1881 Rhinelander, Frederick W.
1898 *Rhinelander, Miss Serena.*
1888 Rhinelander, William.
1874 Rhoades, John Harsen.
1886 *Rice, Isaac L.*
1874 *Richard, Auguste.*
1903 Richard, Edward A.
1901 Riker, John L.
1901 Riker, Samuel.
1874 Riker, William J.
1901 Rives, George Barclay.
1887 *Robb, J. Hampden.*
1903 Robin, Joseph G.
1872 *Robbins, Chandler.*
1891 Robbins, Miss Harriet L.
1889 Roberts, Wm. C., D.D.
1901 *Robertson, Julius.*
1880 *Robinson, Mrs. John A.*
1901 *Robinson, Nelson.*
1888 Robinson, William M.

Date of Election.

1903 Roe, Albert S.
1890 Roe, Major-Gen. Charles F.
1889 *Roelker, Alfred.*
1903 Roelker, William Greene.
1887 *Rogers, Archibald.*
1903 *Rogers, Robert.*
1896 Roncière, St. Croix de la.
1903 Root, William Stanton.
1868 Rose, Cornelius.
1903 Ross, Morgan R.
1876 Ross, William B.
1903 Rossiter, Clinton L.
1895 Rouse, Henry C.
1887 *Rowell, George P.*
1883 *Rowland, Thomas F.*
1897 *Rubino, Jacob.*
1897 Rusch, Henry A.
1899 Russak, Frank.
1899 Russak, Jacob.
1874 *Russell, Archibald D.*
1888 Russell, John E.
1889 Ryan, Thos. F.

1888 *Salisbury, Stephen.*
1897 Salomon, Sidney Hendricks.
1898 Salomon, William.
1901 *Sampson, Alden.*
1875 *Sandford, Elliott.*
1874 Sands, Andrew H.
1895 Sands, Robert C.
1878 *Sands, William R.*
1895 Sanford, Robert.
1886 Satterlee, F. LeRoy, M.D.
1903 *Satterlee, Herbert L.*
1903 Saul, Lester J.
1902 Sawyer, George C.
1870 *Schafer, Samuel M.*
1897 Schaus, Hermann.
1890 Schell, F. Robert.
1874 *Schermerhorn, F. Augustus.*
1890 Schernikow, Ernest.
1898 *Schieffelin, George R.*
1875 *Schiff, Jacob H.*
1902 *Schiff, Mortimer L.*
1903 Schirmer, Gustave.
1903 Schirmer, Rudolph E.
1903 Schloss, Henry W.
1885 Schmelzel, William R.
1901 Schmid, Dr. H. Ernest.
1888 *Schultze, John S.*

Date of Election.

1877 Schuyler, Philip.
1882 *Schuyler, Spencer D.*
1902 *Schwab, Charles M.*
1890 Schwarzmann, A.
1903 Scott, Edward W.
1883 Scott, Rufus L.
1895 Scudder, Moses L.
1897 See, Horace.
1887 Seligman, DeWitt J.
1901 Seligman, Isaac N.
1903 *Sellers, William.*
1887 Sellew, T. G.
1903 *Sells, Elijah W.*
1901 Senter, J. Herbert.
1902 Seward, Frederick W.
1898 Seward, George F.
1898 Seward, Gen. William H.
1893 *Sexton, Edward Bailey.*
1871 Shaler, Major Gen. Alexander.
1897 *Shardlow, Joseph.*
1903 Shaughnessy, Sir Thomas G.
1893 Shaw, Charles A.
1901 Shaw, N. Archibald, Jr.
1895 Shaw, W. M.
1897 Sheehy, W. H.
1888 Sheldon, Edwin B.
1888 *Sherman, Charles A.*
1886 *Sherman, George.*
1856 Sherman, W. Watts.
1903 Sherwood-Dunn, B.
1898 Shillaber, William, Jr.
1903 Shippy, Henry L.
1887 Shortall, John G.
1876 *Sibley, Hiram W.*
1899 Siebert, Wilbur H.
1903 *Siegel, Henry.*
1903 Siegel, Jacob.
1890 Simonson, William H.
1903 Simpson, Ernest L.
1898 Simpson, William T.
1883 *Sinclair, John.*
1901 Slade, William G.
1874 Sloan, Samuel.
1899 Smiley, Albert K.
1901 Smillie, Charles F.
1888 Smith, A. Cary.
1901 Smith, Alfred H.
1893 Smith, Benjamin E.
1901 Smith, Charles Robinson.
1890 *Smith, Sir Donald A.*

Date of Election.
1893 Smith, D. Cady.
1902 Smith, Dr. E. Fayette.
1879 *Smith, E. Reuel.*
1903 Smith, George H.
1899 Smith, J. Frailey.
1887 Smith, James Rufus.
1887 Smith, Nathaniel S.
1901 Smith, Ormond G.
1889 Smith, Philip Sherwood.
1878 Smith, S. Newton.
1883 Smith, William Alexander.
1895 Smith, W. Wheeler.
1902 Smyth, Henry Lloyd.
1888 Smythe, Rev. Hugh.
1890 Snow, Elbridge G.
1903 Snow, Fred W.
1895 Sorchan, Victor.
1883 Sorzano, Julio F.
1880 *Southwick, Henry K.*
1883 Spence, Lewis H.
1856 Spofford, Paul N.
1897 Standish, Myles.
1891 Stanton, John.
1892 Starr, Theodore B.
1901 Stebbins, George L.
1903 Steinway, Frederick T.
1888 Stephens, Benjamin.
1883 Stern, Louis.
1887 Sterry, George E.
1879 Stetson, Francis Lynde.
1887 *Stetson, George W.*
1879 *Stevens, Frederick W.*
1887 Stevens, George T., M.D.
1901 Stevenson, Edward Luther, Ph.D.
1898 Stevenson, Paul Eve.
1895 Stevenson, R. W.
1875 Stewart, Col. Charles Seaforth.
1887 Stewart, Lispenard.
1878 Stewart, William Rhinelander.
1901 *Stickney, Charles D.*
1891 Stieglitz, Edward.
1897 Stine, Marcus.
1892 Stokes, I. N. Phelps.
1884 Stokes, James.
1895 Stone, Mason A.
1883 Stone, Sumner R.
1897 Stotesbury, Louis W.
1889 Strauss, Isidor.
1903 Strauss, Frederick.
1873 Sturges, Frederick.

Date of Election.
1875 Sturges, Henry C.
1901 Sturges, William C.
1873 *Sturgis, Frank K.*
1901 Sturgis, Thomas.
1874 Stuyvesant, Robert R.
1872 *Stuyvesant, Rutherfurd.*
1891 *Suckley, Robert B.*
1887 Sutton, J. Ford, D.D.
1903 Sutton, James F.
1893 Swayne, Francis B.

1882 *Tailer, Edward N.*
1877 *Talcott, James.*
1889 Tatham, Charles.
1901 Tatlock, John, Jr.
1902 Taylor, Charles H., Jr.
1898 Taylor, Charles M., Jr.
1868 Taylor, Douglas.
1902 Taylor, F. F.
1902 Taylor, Frederick.
1895 Taylor, George.
1903 Taylor, Henry R.
1901 Taylor, Walter C.
1889 Tefft, F. Griswold.
1882 *Terry, John T.*
1876 *Terry, Rev. Roderick.*
1901 Terry, Walter Phillips.
1900 Tesla, Nikola.
1883 Thalmann, Ernest.
1891 Thaw, Benjamin.
1897 Thomas, Geo. C.
1901 Thomas, John Lloyd.
1898 Thompson, D. W.
1902 Thompson, John C.
1901 *Thompson, Lewis S.*
1898 Thompson, Walter.
1902 *Thomson, Elihu.*
1886 Thorne, Jonathan.
1890 Thorne, Samuel.
1890 Thorp, John R.
1893 *Tichenor, Francis M.*
1885 Tiffany, C. C., D.D.
1891 *Tobey, Gerard C.*
1901 Todd, Rev. William E.
1875 Toel, William.
1897 Tonnelé, Walter.
1900 Tracy, J. Evarts.
1897 Treacy, Richard S.
1888 Tresidder, John R.
1893 Trusdell, Warren N.

Date of Election.
1899 *Tucker, George F.*
1901 *Tuckerman, Alfred.*
1901 Tuckerman, Paul.
1884 Turner, J. Spencer.
1900 Turnure, George.

1888 *Uhl, Edward.*
1891 Ullmann, Emanuel S.
1891 Ulmann, Ludwig.
1902 Ulloa, G., Juan J.
1897 *Underhill, Eugene.*
1897 Untermyer, Maurice.

1890 Valentine, Ferdinand C., M.D.
1887 *Van Alen, J. J.*
1897 Van Antwerp, William C.
1901 van Beuren, F. T., Jr., M.D.
1870 *Van Brunt, Charles H.*
1875 Van Buren, John D.
1889 *Vanderbilt, George W.*
1878 *Vanderbilt, William K.*
1895 Vanderpoel, Waldron B., M.D.
1876 Van Hoesen, George M.
1900 Van Holland, Henry.
1902 *Van Rensselaer, A.*
1887 *Van Slyck, George W.*
1891 *Van Winkle, Edgar B.*
1887 Verastegui, Alberto de.
1888 Ver Planck, Wm. G.
1900 *Vetter, Dr. Charles.*
1898 Voelker, John Ph.
1901 von Briesen, Arthur.
1875 *von Post, Herman C.*
1903 von Schmid, J. O.
1899 Vorse, Albert White.
1902 Vose, Edward N.
1890 Vose, Geo. H.

1890 *Wadsworth, Herbert.*
1898 *Wadsworth, Wm. Austin.*
1898 Wait, William B.
1898 Wales, C. M.
1900 Walker, Henry Freeman, M.D.
1898 Walker, William Augustus.
1903 Wallace, William H.
1898 Warburg, Felix M.
1900 Wardwell, William T.
1898 Warner, James Harold.
1902 *Warren, Samuel D.*
1895 Warren, William R.

Date of Election.
1900 Washington, W. D'H.
1899 Waterbury, John I.
1898 *Watkinson, George.*
1879 *Watson, Francis A.*
1884 *Watson, George H.*
1876 Wedemeyer, A.J. D.
1900 Weeks, John R.
1900 *Wehrhane, Charles.*
1903 Weir, Col. John.
1895 Wells, Charles W.
1897 Wenman, James F.
1902 Wensley, Robert L.
1901 Wentz, James M.
1898 Weston, Edward.
1900 Wetherbee, Gardner.
1899 Wetherill, Henry Emerson, M.D.
1888 Wetmore, Edmund.
1874 *Wetmore, George P.*
1872 *Wetmore, William Boerum.*
1901 *Wetmore, W. S. K.*
1887 Wheelock, G. G., M.D.
1903 Wheelock, William E.
1903 White, Abraham.
1868 White, Alexander M.
1887 White, Alfred T.
1887 White, Henry.
1902 White, Henry Clay.
1886 White, Horace.
1887 *White, Julian LeRoy.*
1886 *White, S. V.*
1887 White, William Augustus.
1878 *Whitehead, Henry M.*
1901 Whitehouse, William FitzHugh, Jr.
1898 Whitfield, R. P.
1903 Whitney, Horace P.
1891 Whitney, Milton B.
1902 *Whitney, W. Beaumont.*
1873 *Wiener, Joseph, M.D.*
1902 Wilgus, William J.
1898 Wilkins, Hartwell A.
1901 *Willcox, David.*
1901 *Willets, Howard.*
1900 Willets, John T.
1895 *Willets, Robert R.*
1901 Willits, Frederick E.
1882 *Williams, David.*
1902 *Williams, John Skelton.*
1901 Williams, John T.
1901 *Williams, Timothy S.*
1893 Wills, Charles T.

Date of Election.
1903 Wilson, Henry R.
1870 *Wilson, Gen. James Grant.*
1881 Wilson, John.
1888 Winslow, Dan.
1875 Winslow, Gen. Edward F.
1901 Winslow, John Flack.
1902 Winter, Emil.
1900 *Winthrop, Grenville L.*
1888 Witherbee, Frank S.
1891 Wolcott, Henry Roger.
1897 Wolff, Emil.
1903 Wood, Henry R.
1900 Wood, Orrin S.
1903 Wood, Rufus H.
1884 Wood, William H. S.

Date of Election.
1895 Woodford, M. D.
1898 Woods, Edward A.
1898 Woods, John A.
1888 *Woodward, James T.*
1886 Wright, William Phillips.
1902 Wyckoff, Clarence F.
1902 *Wyckoff, Edward G.*
1901 Wyckoff, William F.

1891 Young, Edward L.
1895 Young, Richard N.

1884 *Zabriskie, Andrew C.*
1898 Zaring, Charles W.
1900 *Ziegler, William.*

Members and Fellows Deceased, October 27, 1899, to June 30, 1903.

Ropes, John C., October 27, 1899.
Webb, William H., October 30, 1899.
Moir, James, December 7, 1899.
Ponce de León, Néstor, December 19, 1899.
Miller, George C., January 4, 1900.
Holden, E. F., January 5, 1900.
Bissinger, Philip, January 10, 1900.
Davison, Charles A., January 18, 1900.
Fitz-Gibbon, Edward, February 12, 1900.
Bend, George H., February 15, 1900.
Aub, Albert, February 26, 1900.
Grafton, Joseph, March 4, 1900.
Tower, Maj.-Gen. Z. B., March 21, 1900.
Mali, Henry W. T., March 28, 1900.
Martin, Mahlon C., April 4, 1900.
Alling, Asa A., April 14, 1900.
Hallidie, A. S., April 25, 1900.
Huntington, Charles P., April 20, 1900.
Bernheimer, Simon, April 26, 1900.
Bishop, D. W., May 1, 1900.
Taintor, Charles M., May 5, 1900.
Schell, Robert, May 8, 1900.
Constable, James M., May 12, 1900.
Marquand, John Phillips, June 4, 1900.
Wolfe, J. Burke, June 10, 1900.
F. Wayland Fellowes, June 16, 1900.
Curtis, Benjamin L., June 16, 1900.
Steinbrügge, Edward, June 28, 1900.
Coddington, Gilbert S., July 16, 1900.
Ottiwell, John D., July 17, 1900.
Knauth, Percival, July 17, 1900.
Garland, James A., July 26, 1900.
Dunlap, Robert, August 2, 1900.
Huntington, Collis P., August 13, 1900.
Wilson, J. Wall, August 21, 1900.
Pierce, Moses, August —, 1900.
Turner, Elisha, September 14, 1900.
Sayre, Lewis A., September 21, 1900.
Ames, Caleb Tyler, September 27, 1900.
Hudson, John E., October 1, 1900.
Bixby, Robert F., October 16, 1900.
Cameron, Sir Roderick W., October 19, 1900.
Warner, Charles Dudley, October 20, 1900.
Squibb, E. R., October 26, 1900.
Stryker, Gen'l William S., October 29, 1900.
Niles, William W., October 30, 1900.
Strong, William L., November 2, 1900.
Stott, Frank N., November 4, 1900.
Dun, R. G., November 10, 1900.
Villard, Henry, November 12, 1900.
King, John A., November 21, 1900.
Bunker, Matthew, December 11, 1900.
Beaman, Charles C., December 15, 1900.
Ottendorfer, Oswald, December 15, 1900.
Meyer, F. William, December 19, 1900.
Goodridge, John C., Jr., December 27, 1900.

Hitchcock, Hiram, December 30, 1900.
Frazar, Everett, January 3, 1901.
Amy, Henry, January 11, 1901.
McCarter, Thomas N., January 11, 1901.
Peabody, Arthur J., January 13, 1901.
Morrison, Henry, January 14, 1901.
Hendricks, Clifford B., January 14, 1901.
McAlpin, David H., February 8, 1901.
Evarts, William M., February 28, 1901.
Moss, H. O., March 2, 1901.
Smith, Henry N., March 13, 1901.
James, Edward C., March 24, 1901.
Bliss, George T., March 24, 1901.
Stevens, Charles Albert, March 27, 1901.
Rice, J. M., March —, 1901.
Chaix, Prof. Paul, March 28, 1901.
Constantine, Andrew J., April 13, 1901.
Parsons, William, April 16, 1901.
Coppell, George, April 19, 1901.
Dunham, James H., April 28, 1901.
McCormick, Richard C., June 2, 1901.
Peabody, Charles A., July 3, 1901.
Scott, Julian, July 4, 1901.
Fiske, John, July 4, 1901.
Lorillard, Pierre, July 7, 1901.
Taylor, Alfred J., July 12, 1901.
Dunscomb, Richard T., July 16, 1901.
Kelly, Edward, July 27, 1901.
Arnot, Matthias C., July 31, 1901.
Nordenskiöld, Baron A. E., August 12, 1901.
Hand, Clifford A., August 18, 1901.
Owen, Mrs. Thomas J., August 21, 1901.
Robbins, S. Howland, September 4, 1901.
Armour, Herman O., September 8, 1901.
West, George, September 19, 1901.
Douglass, Andrew E., September 30, 1901.
Sturges, Edward, November 2, 1901.
Bauchle, Thomas H., December 18, 1901.
Spencer, James C., December 22, 1901.
Maunoir, Charles, December 22, 1901.
King, Clarence, December 23, 1901.
Cochran, William F., December 27, 1901.
Sewell, William J., December 27, 1901.
Laidlaw, H. B., January 8, 1902.
Bacon, Lathrop R., January 18, 1902.
Faye, James J., January 27, 1902.
Faile, Thomas H., January 26, 1902.
Compton, A. T., January 30, 1902.
Carter, Aaron, January 31, 1902.
Milliken, James, February 4, 1902.
Dufferin and Ava, Marquis of, February 12, 1902.
Bierstadt, Albert, February 18, 1902.
Tiffany, Charles L., February 18, 1902.
Marquand, Henry G., February 26, 1902.
Goodridge, Mrs. Frederic, March 3, 1902.
Doudge, James R., March 12, 1902.
Hitchcock, Henry, March 18, 1902.
Jaffray, Robert, April 12, 1902.
Coutan, Adolphe R., May 16, 1902.
Crawford, Francis, June 1, 1902.
Armstrong, George E., June 11, 1902.
Townsend, Randolph W., June 16, 1902.
Hoffman, Eugene A., June 17, 1902.
Baker, Cyrus O., July 4, 1902.
Mackay, John W., July 20, 1902.
Rexford, W. M., July 20, 1902.
Schafer, Simon, July 28, 1902.
Butler, William Allen, September 9, 1902.
Babcock, Samuel D., September 14, 1902.
Howells, Henry C., October 11, 1902.
Bennet, Ludovic, November 6, 1902.
Owens, William F., November 9, 1902.
Lewis, Enoch, November 15, 1902.
Livermore, Frank, November 18, 1902.
Chrystie, Wm. F., December 3, 1902.
Tillinghast, William H., December 9, 1902.
Adams, Charles H., December 14, 1902.
Farmer, Silas, December 28, 1902.
Irwin, William, December 31, 1902.
Schermerhorn, W. C., January 1, 1903.
Haskins, Charles W., January 9, 1903.
Marié, Peter, January 13, 1903.
Flanagan, William L., January 18, 1903.
Hewitt, Abram S., January 18, 1903.
Freeman, William C., February 7, 1903.
McCreery, James, February 26, 1903.
Turnbull, Robert J., March 2, 1903.
Johnes, Edward R., March 28, 1903.
Lawrence, John S., April 1, 1903.
Ivison, David B., April 6, 1903.
Wilson, J. B., April 22, 1903.
Du Chaillu, Paul B., April 30, 1903.
Brookfield, William, May 13, 1903.
Musgrave, Thomas B., June 1, 1903.
Hoyt, Ezra P., June 9, 1903.
Hoyt, Alfred M., June 18, 1903.

BOOK NOTICES.

Handbook of Climatology, by Dr. Julius Hann. Part I. General Climatology. Translated, with the author's permission, from the second revised and enlarged German edition, with additional references and notes, by Robert De Courcy Ward, Assistant Professor of Climatology in Harvard University. New York (The Macmillan Co.) 1903. XIV, 437 pp.

Dr. Julius Hann's Handbuch der Klimatologie has for many years been the standard text-book of the principles of climatology for teachers and advanced students. The translation, by Mr. Ward, of Harvard College, of the second edition of this great work will prove to be a welcome contribution from the press of Macmillan Company by opening up the results of the best modern research to a much larger circle of readers. The first edition appeared in 1883, in the "Library of Geographic Handbooks," published by Friedrich Ratzel, in Stuttgart, and at once took first rank as a text-book of instruction in climatology. In 1897 a second edition appeared, carefully revised and greatly enlarged. Into this book the author, Dr. Julius Hann, of the University of Vienna, has put the best fruits of a long and productive career of research and instruction. For more than thirty years Dr. Hann has been an active worker in the field of meteorology, as investigator, administrator, instructor, and editor. It is safe to predict that his handbook will continue for many years to come to afford inspiration and instruction to students interested in the climates of the globe.

The second edition comprises three volumes, with a total of about twelve hundred small octavo pages of text. The first contains the principles of climatology, discussing factors involved in climate in general—the solar climate, the principal forms of modified terrestrial climates, and the causes of climatic changes. The second and third volumes are devoted to regional or descriptive climatology, treating separately the climates of the equatorial regions, the temperate regions, and the polar regions.

In defining the scope of the Handbook the author calls attention to the difficulties encountered in attempting to draw sharp lines of distinction between climatology and meteorology. Climatology is treated in its more restricted sense as a part of meteorology—that part which deals with the sum total of the average conditions of

the atmosphere at any given place. "Meteorology, when taken in a restricted sense, seeks to explain the various atmospheric phenomena by known physical laws, and to discover the causes underlying the succession of atmospheric processes." It is impossible, however, to treat either subject satisfactorily without including much of the other. The practical difficulties of deciding how much of *meteorology* to include in his *climatology* have been largely eliminated in the present case by the author's recent publication of a "Treatise on Meteorology." These two publications are supplementary and form a comprehensive and invaluable repository of the best knowledge of atmospheric conditions and processes. The great number of references to original sources of information contained in the footnotes attest the wide reading and scholarly preparation of the author, and will greatly aid the student who may desire to go more deeply into the subjects treated than the limits of a single text-book will permit.

Only the first volume of the second edition has been translated by Mr. Ward primarily, in order that it might serve as a text-book for students in the course in general climatology in Harvard College. The great additional cost of time, labour, and expense which the two volumes on regional climatology would have involved made it impracticable to include them in the translation. The first volume is, however, complete in itself, and does not lose in value by separation from the others. The translation essentially reproduces the original, although numerous additional paragraphs are inserted in order to introduce the results of researches which have appeared since the publication of the German edition in 1898, especially such as are derived from American sources. Additional footnotes and literary references are also of frequent occurrence, adding greatly to the value of the translation. Just how much new material has been introduced into the American edition by the translator can be determined only by careful comparison with the original, as there is no distinguishing mark to separate the old from the new. According to the translator's preface, however, the author has accepted all changes and additions, thereby making them his own. The paragraph headings have been largely increased in number, facilitating reference to particular subjects.

The metric system of the original has been wisely retained in the translation, but conversion tables are added in an appendix for the convenience of readers who can think only in the cumbersome system of English weights and measures. Diagrams are few in number, but simple and effective when used at all.

The translation has been carefully done; the meaning of the original has been clearly and accurately reproduced—a task not always easy in view of the German fondness for long and involved sentences.

Mr. Ward has put into this volume much time and thought, and much labour which may be regarded as unremunerative when measured in dollars and cents, but he has made easily accessible to the American and English student and instructor the best book in the market of the principles of climatology for use in our higher institutions of learning.

It is to be hoped that Mr. Ward, or some one equally competent, will set himself the task of translating Dr. Hann's more recent work, "A Treatise on Meteorology," published in 1901 by Tauchnitz of Leipsic. This is the crowning work of a long and active life devoted to the advancement of our knowledge of the physics of the atmosphere. The volume deserves an early translation into English and a place beside the "Handbook of Climatology." F.

Geography of Minnesota, by C. W. Hall, Professor of Geology and Mineralogy in the University of Minnesota, 299 pp. The H. W. Wilson Company, Minneapolis, 1903.

Professor Hall has made a useful book for the general reader and the high school student of Minnesota, and a valuable book of reference for teachers of geography and others who may need to find in compact form the facts of the geography of this great northwestern State. The subject is treated in a number of short chapters, with ample illustrations. Some of the larger maps, as, for example, the elevation map, opposite pa5e 8, do not equal in quality the pictorial illustrations, and might be redrawn, to the improvement of a volume which as a whole deserves much praise.

The work is rather broadly geographic, and devotes several chapters to topics in meteorology. Then it passes to the ice invasions, springs, and ground waters and streams. The general principles of the several subjects are treated, making the book of value to untrained readers. Several excellent chapters are given to the lakes, both existing and glacial. Other topics are: prairies, forests, hills, mountains, rocks, and minerals. Thus the number of texts, describing in compact form a single State, is slowly increasing; but we must still, for most States, search through many volumes, and we have nothing to offer the inquiring reader.

A. P. B.

The Glacial Geology of New Jersey, by Rollin D. Salisbury. Volume V of the Final Report of the State Geologist. Trenton, 1902.

This volume may be taken as an illustration of the remarkable advance of glacial geology in recent years. We find 802 pages, with a generous outfit of maps and pictures descriptive of the surface formations of the northern part of a small State—formations which the earlier geologists regarded as a hindrance to their work, which now, however, are recognized as of the greatest meaning to the farmer, builder, engineer, and, indeed, to every thoughtful person. Previous volumes of the Final Report cover Topography, Climate, Magnetism, Mineralogy, Botany, Zoology, Water Supply, and Physical Geography. The geographic features of the State are therefore very broadly and fully treated with the issue of this report on the glacial geology.

A considerable section (226 pp.) is devoted to principles making it possible for a resident of New Jersey to take up the subject without a separate text-book. The principles are, however, developed with especial reference to the State concerned. No question is more common, or harder to answer, than that relating to the thickness of the ancient ice. The author gives a cautious estimate for the north line of the State, that the maximum thickness of the ice

was somewhere between 1,500 and 2,500 feet, and its minimum between 1,000 and 1,500 feet, when the ice was at its maximum stand.

As regards the measure of glacial erosion, Professor Salisbury thinks that hills and ridges were smoothed, but without serious modifications of general configuration. It is recognized, however, that this area lies on and near the glacial boundary, where movement was less powerful and less prolonged. Exceptional erosion, in certain localities, by plucking is noted, as along the Palisades ridge, which the ice crossed to the southeastward, carrying blocks from the top of the cliff to Manhattan, Staten, and Long Islands.

The thickness—or thinness, perhaps, we should say—of the drift points to moderate glacial erosion. Twenty or twenty-five feet is the minimum, and forty or fifty feet a possible maximum thickness, even including the moraine belt. New Jersey was not without its temporary or glacial lakes; and the history of "Lake Passaic" was given several years ago by Dr. H. B. Kümmel, the present State Geologist. This history is repeated in this volume. The section on general principles closes with a history of the glacial period. Part 2, including the rest of the volume, is devoted to

local details. These are presented under the following heads: the Terminal Moraine; the Drift of the Appalachian Province; the Drift of the Highlands; the Drift of the Triassic Plain; Stratified Drift of Late Glacial Age South of the Moraine; and Extra-Morainic Glacial Drift. This extra-morainic drift is referred, doubtfully, to the Kansas epoch. A pocket at the end of the volume contains several maps, among them one showing the direction of glacial movements and one giving the distribution of the glacial drift. A. P. B.

The New York City Folio, of the Geologic Atlas of the United States. U. S. Geological Survey, Folio No. 83. Washington, D. C., 1902.

This folio includes the Paterson, Harlem, Staten Island, and Brooklyn quadrangles of New York and New Jersey, containing more people than any similar area in the New World, the population by the last census being 4,560,800. In plan the work is similar to other Survey Folios giving geological history and resulting geographic features and resources. As with the others, the inside cover pages contain a copious explanation, a kind of key to the terminology and the elaborate maps which are used.

The general geography is described by Richard E. Dodge and Bailey Willis. The drainage features are given in detail in connection with a map, which also shows depths to ten fathoms by contour lines. The geology is given in a series of papers by several authors. The outline of geologic history is by Bailey Willis, and is followed by more detailed accounts of the formation and of the periods to which they belong. Dr. F. J. H. Merrill describes the metamorphic crystalline rocks. Of these the chief representatives are: the Fordham Gneiss, which is pre-Cambrian; the Poughquag Quartzite, which is Cambrian; the Stockbridge Dolomite, a Silurian formation continuing from Western New England; and the Hudson Schist, equivalent to the Berkshire Schist of New England. Various younger rocks are igneous in character, and occur as intrusives in those named above. The Stockbridge Dolomite furnishes the marble of Tuckahoe, and, by the ease of its erosion, has determined along its belts the existence of the now submerged valleys which have made New York what it is.

A much more detailed paper is by Mr. N. H. Darton, and deals with the Jura-Trias, here known as the Newark Group, consisting of reddish brown shales and sandstones, and having, in association

with its strata, those sheets of volcanic rock which form the Palisades of the Hudson and the Watchung or Orange Mountains. Even the non-geological reader of the Folio will find Mr. Darton's Fig. 3 of much interest, as it shows the relations of the sandstones and the lava masses, from the gneiss, on the east of the Hudson, westward, to the gneiss of the New Jersey Highlands beyond Orange. We have the sedimentary rocks dipping westward with the Palisades trap, the Snake Hill trap, and the first, second, and third Watchung traps, in order, going westward. Below the geologic section is drawn a true profile of the surface, without vertical exaggeration, and the two taken together are fitted to give the reader true and permanent information. The Watchung lava sheets and the Palisades are described in sufficient detail to make the Folio of much value as a local guide. The Palisades are formed by the intrusion of a single sheet, which at some points is known to have been 1,000 and more feet in thickness.

Mr. Willis and Dr. Arthur Hollick give short sketches of later geologic events, which, however, have left small records in this immediate field, until we reach the Pleistocene formations, which are described at length by Professor R. D. Salisbury, from his studies in connection with the Geological Survey of New Jersey.

An introductory statement of general principles is given, which will aid the general reader, and the local description begins with a map showing the direction of glacial movements and the course of the terminal moraine. The latter crosses New Jersey by Morristown and Perth Amboy, and then swings to the northwest across Staten Island, and begins its long extension, by Brooklyn and Jamaica, through Long Island. The drift is usually thin, outside of the morainic belts, and glacial scratches and mouldings of the rocks are frequent, especially east of the Hudson River and north of East River and the Sound, as at many points in Central Park. The post-glacial changes are moderate in amount, and consist of stream and shore erosion, weathering of the glacial drift, the blowing of sand, accumulation of sand by waves, and the growth of beds of peat.

A short section by Bailey Willis and R. E. Dodge is devoted to physiographic features, including the origin of New York Harbour, the development of shore features, the relations of valleys and of heights, and the water and wind gaps. The development of valleys on the dolomite, referred to by Dr. Merrill, is here more fully treated. The effects of physiographic features on culture are briefly treated, and the text closes with an account of the water

supply of New York City, by Henry A. Pressey. The four quadrangles are shown in contoured maps, while a second set gives the historical geology, and a third the surficial geology. There is a structural map of the Harlem quadrangle, and two illustrative sheets reproduce views of the Palisades, the Watchung traps, the Falls of the Passaic River at Paterson, the terminal moraine on Staten Island, and glaciated rock surfaces in Bronx Park. The Folio is the best guide to the geology of the region, while its inconvenient size finds ample compensation in the elaborate maps which compel the use of the folio form. A. P. B.

The Tanganyika Problem. An Account of the Researches undertaken concerning the Existence of Marine Animals in Central Africa. By J. E. S. Moore, F.R.G.S. London: Hurst & Blackett, Ltd., 1903.

This book is the result of Mr. Moore's two expeditions to the lake region of Central Africa especially to study the occurrence of animals of a distinctly marine type in Lake Tanganyika, and the problem of a former connection between the sea and the lake by which the animals were originally introduced. The volume, being thus devoted to the consideration of animal life in the lakes and of the ancient physiography of Central Africa, is almost wholly biological and geological; it is geographical, however, so far as it deals with the present distribution of animal life and with the former physical geography of Africa. The value to zoology of the studies undertaken is evident from the fact that nearly 200 entirely new animal types were discovered; and the book is the only one containing an extended illustrated account of the animals found in the great African lakes. The difficulty of accounting for the existence of the marine types in Tanganyika is increased by the fact that none of them is found in the other central lakes from Rudolf to Bangweolo and Nyasa. The absence of these shells from the other lakes is opposed to the theory that the marine types reached Tanganyika through the Red Sea or the Indian Ocean; and Mr. Moore's geological studies incline him to the view that they may have inhabited a Jurassic sea which is supposed to have extended over a large portion of the Congo basin, a part of it occupying the Tanganyika area. Some of Mr. Moore's hypotheses are not fully accepted either by biologists or geologists; but all will admit the thoroughness of his investigation of the Tanganyika fauna, the great merit of his descriptions and illustrations

of the animals found, and the considerable additions to geological knowledge of the region of the central lakes, to which his colleague, Mr. Fergusson, especially contributed.

The Scope of Geographic Investigation in Lakes (*Die Aufgabe Geographischer Forschung an Seen*)*. *By Prof. Dr. Willi Ule, Privatdocent in the University of Halle.*

Limnology, the science of lakes, starting as a branch of geography, has of late developed into an independent science, drawing upon quite a number of sciences. It is time to define the principles according to which its problems are to be included in or excluded from geography.

Forel's classification of limnology exceeds the geographic scope, since he divides it into hydrography, geology, petrography, hydrology, climatology, chemistry, thermics, optics, and biology. Ule, laying stress on the geographic point of view, makes the following classifications:

1. General geographic conditions.
2. Morphology and geology of lakes.
3. Physical conditions of the water.
4. Chemical composition of the water and of its deposits.
5. Biologic conditions.
6. Anthropogeographic significance of lakes.

To illustrate the distinction, he observes that the investigation of the thermic conditions is mainly a physical or limnologic problem, while the explanation of the differences in temperature among lakes is mainly the task of the geographer. He proceeds to enumerate the geographic problems under each of the six headings of his classification.

1. (*a*) First among *general geographic conditions* is the description of the location, shape, and size of lakes. These suggest classifications (lakes of coasts, river lowlands, folded areas, fractured areas, volcanic, glacial, and drainless regions). (*b*) Description of the tributary basin, including supply and drainage, and involving a discussion of the climatology. (*c*) Budget of the lake, that is, relation between inflow and outflow. (*d*) Height of water, including oscillations, which, by comparison with record of precipitation, show whether the lake is fed mainly by surface water or by ground

* From Abhandlungen der K. K. Geographischen Gesellschaft in Wien, IV Band, 1902, No. 6. Wien, 1902.

water. (*e*) The mode of feeding suggests a new classification (rain-fed, groundwater-fed, spring-fed, river-fed, glacier-fed). (*f*) Influence of lakes on climate, which may throw light on anthropogeographic and phytogeographic problems. The freezing of lakes is a geographic problem, because dependent on location, and because its duration influences human conditions. The cause of freezing and its physical mechanism, on the other hand, belong to the province of the limnologist.

2. (*a*) First among problems of *morphology and geology* is the comparison of the shape of the lake basin with the surrounding orography. Was the lake created by the same process as the rest of the land surface, or subsequently? Different classes of land are wont to be characterized by different types of lake basins. Thus, in the arid regions, lakes, as a rule, are quite shallow; if deep lakes occur there, they are of different origin. (*b*) The shape of the lake basin is determined by its mode of origin. A trough-like form indicates glacial origin. Dammed river valleys show the marks of running water. (*c*) From soundings the mean depth and the relation of this and of the greatest depth to the area of the lake may be calculated. (*d*) Influence of the geologic age and structure of the country rock. (*e*) Influence of recent processes, such as changes in shores and fillings of the basin, often suggesting explanations of earlier processes. The transformation of the shores is the effect of wave-beat, wind and rain. Do these work in the same or in opposite directions? Do they vary with the height of water? The filling with sediment is partly eolian and partly river-borne—the former prevailing in arid, the latter in humid countries. Annual measurements of deposits show rate of filling. Delta formation is governed by mud-carrying capacity of rivers and by oscillations of lake level. From volume of deposits and rate of deposition the age of some alpine lakes, beginning with the close of the glacial period, has been calculated at 16,000 to 32,000 years. (*f*) Morphologic and geologic conditions often serve to explain the origin of the lake. This is eminently a geographic problem, since many types of lakes are confined to certain strongly-marked geographic provinces. (*g*) The mode of origin suggests another classification. Ule makes the division into primary and secondary lakes, each being subdivided according to the nature of the lake-creating forces.

3. As regards the *physical conditions of the water*, it is more difficult to define the province of geography. The physical conditions are static and dynamic, thermic, optic, and acoustic.

Statics and Dynamics.—Certain deformations of lake level may be due to attraction by land masses. The phenomenon of *seiches* has been observed in nearly all large lakes. Is it influenced by geographic location or climate or by the condition of the atmosphere? The wave-beat determines the action on the shore and influences navigation. Currents have been observed in some lakes.

Thermics.—Hardly any two lakes show the same temperature record. It is the geographer's task to study the variations by comparison with geographic location. Sometimes thermic peculiarities are due solely to local surroundings. The relations between water temperature and air temperature, and between temperature and evaporation, furnish subjects of inquiry.

Optics.—Many lakes, geographically alike, show the same colour, though considerably different in physical constitution. The North German lakes, as a rule, are less transparent than the Alpine lakes. Is this due to different geographic conditions?

Acoustics.—The so-called air-puffs, peculiar detonations heard at the seashore and on lakeshores, can only be explained when their geographic distribution shall have been ascertained.

4. As regards the *chemical composition*, the geographer is called upon to study it with reference to the surroundings. Artificial colouring enables the course of subterranean water to be traced. What becomes of the substances, in suspension or solution, contributed by rivers? Is their transformation dependent on geographic conditions? Passarge found that a large part of the meadow-lime deposits originated from vegetal mud in lakes subsequently filled. Comparison of results from different lakes would show any existing influence of geographic factors.

5. The importance of *biologic conditions* is illustrated by Samter's discovery, in Madü lake, of marine crustaceans that are to be regarded as relicts of the glacial period. To what extent can marine animals adapt themselves to fresh water? While the limnologist investigates the organic world of lakes, the geographer has to inquire into its origin and its significance for the lake phenomenon. At times the flora or fauna may furnish hints as to the age of a lake.

6. The *anthropogeographic significance* of lakes is evident. They furnish drink and food, and are often surrounded by fertile lowlands, thus inviting settlement. They are, probably, favoured as regards climate. They interrupt commerce by land, aid it by navigation, attract it by the settlements along their shores. Where they

freeze in winter, travel is transformed. They are apt to serve as gathering-points for the commerce of the tributary valleys. They furnish power. Finally, they are regulators of outflow, dominating the valleys below.

Prof. Ule's paper must be regarded as a suggestive contribution to the irksome but unavoidable task of drawing sharp lines where none exist in nature. If we define geography simply as the science of the earth, it manifestly embraces all the sciences, including law and theology. If we exclude from it everything that belongs to another science, there will be no geography left. Hence, if we are to have a science of geography, we must add to the generic term "science of the earth" some specific point of view from which the earth is regarded. Ritter's definition of geography as "the science of the relation between earth and man" seems to be most in favour. Ule, in his closing remarks, defines the scope of modern geography to be "the investigation of the reciprocal effects of the several phenomena of a country, and their causal connection." It may be questioned whether either definition will enable us in any particular case to say: This belongs to geography; or, This does not belong to geography. However, since this specialization is the order of the day, there is no doubt that in the future the debatable ground between geography and other sciences will bear an ever-lessening proportion to the well-recognized field covered by the definition of geography, whatever that definition may eventually be. The present work is clearly a step in that direction. R. S.

Unknown Mexico. A Record of Five Years' Exploration among the Tribes of the Western Sierra Madre; in the Tierra Caliente of Tepic and Jalisco; and among the Tarascos of Michoacan. By Carl Lumholtz, M.A., Member of the Society of Sciences of Norway; Associé Étranger de la Société d'Anthropologie de Paris; Author of "Among Cannibals," etc. Illustrated. New York, Charles Scribner's Sons, 1902. 2 vols. 8vo.

Mr. Lumholtz describes in these volumes the results of four journeys in the Western Sierra Madre—the first in 1890–91, the second in 1892–93, the third in 1894–97, and the fourth in 1898, with Dr. A. Hrdlicka.

It was a happy inspiration that led him to seek among the tribes inhabiting this great range the beliefs and manners and practices which have survived the Conquest, and the ethnologist will be

grateful for the equally happy chance which brought these practically unknown peoples under the observation of a scientific mind, before it was too late. Mr. Lumholtz lived for a year and a half among the Tarahumares and for ten months among the Coras and the Huichols, learning their languages and gradually winning the confidence which they are slow to repose in the white man; he studied also the Tepehuanes, the Tepecanos, the Nahuas, and the Tarascos. All, even the four tribes of the Sierra Madre, understand Spanish, and must in no long time be absorbed by the invading Mexican civilization. The type is precious to the student of manners; but Nature is willing that all shall go, to be lost in the civilizations that rise and fall.

Life passes quietly enough in the Sierra Madre. The Tarahumare rises and retires with the sun. In the morning he sits near the fire till his wife brings his breakfast of *pínole* (parched corn, ground and mixed with sugar and water) and roasted mice, from the traps set in the fields. The man takes his bow and arrows, or his axe, and goes hunting; the woman spends the day grinding corn, or weaving, or keeping house, like a Roman matron. When the man comes home with game he carries it under his blanket, lest a neighbour, seeing it, may expect an invitation to dinner. When not engaged abroad, the man busies himself making a bow or arrows, or playing on his home-made violin or guitar.

These Indians are not hospitable, though polite. The manner of paying visits is peculiar, and calculated to stir the envy of those who live in cities. Good manners require that the visitor shall stop twenty or thirty yards from his friend's house, with his face turned away from it. There he stays for an hour or two and then retires, if not invited in by the master of the house.

Among the most curious practices of the Indians is the *híkuli* cult, common to the Tarahumares and the Huichols, though these tribes are separated by hundreds of miles. The híkuli is a cactus (*Lophophora Williamsii* and *Lophophora Williamsii*, var. *Lewinii*), known in the United States by the name of *mescal button.* The plant lives for months after it has been rooted up, and the eating of it causes a state of ecstasy. It is regarded as a demi-god, and worshipped.

Mr. Lumholtz found that the híkuli produced exhilaration and allayed hunger and thirst. It does away with exhaustion and supplies energy, resembling in this respect the Peruvian coca; but, unlike the coca, it leaves a feeling of depression and a headache. It also produces colour-visions.

It is among the Huichols that the híkuli worship has attained the greatest elaboration, as one expression of the religious feeling for which they are remarkable. Their food supply depends upon rain, and all their prayers are, first for rain and then for health, luck, and long life. Their religion, though a form of shamanism, appears to have something in common with more advanced developments.

This most interesting and instructive work is illustrated by more than 400 reproductions of photographs of scenery and persons, as well as of objects collected by Mr. Lumholtz and deposited in the American Museum of Natural History. Mention must also be made of the map of the Sierra, undoubtedly the best as yet within reach; and it must be noted that the Spanish words and phrases, frequently incorrect, were not read in proof by the author.

THE

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BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXV **1903.** **No. 4**

THE EARTHQUAKE AND VOLCANIC ERUPTION IN GUATEMALA IN 1902.

BY

GUSTAV EISEN, PH.D.

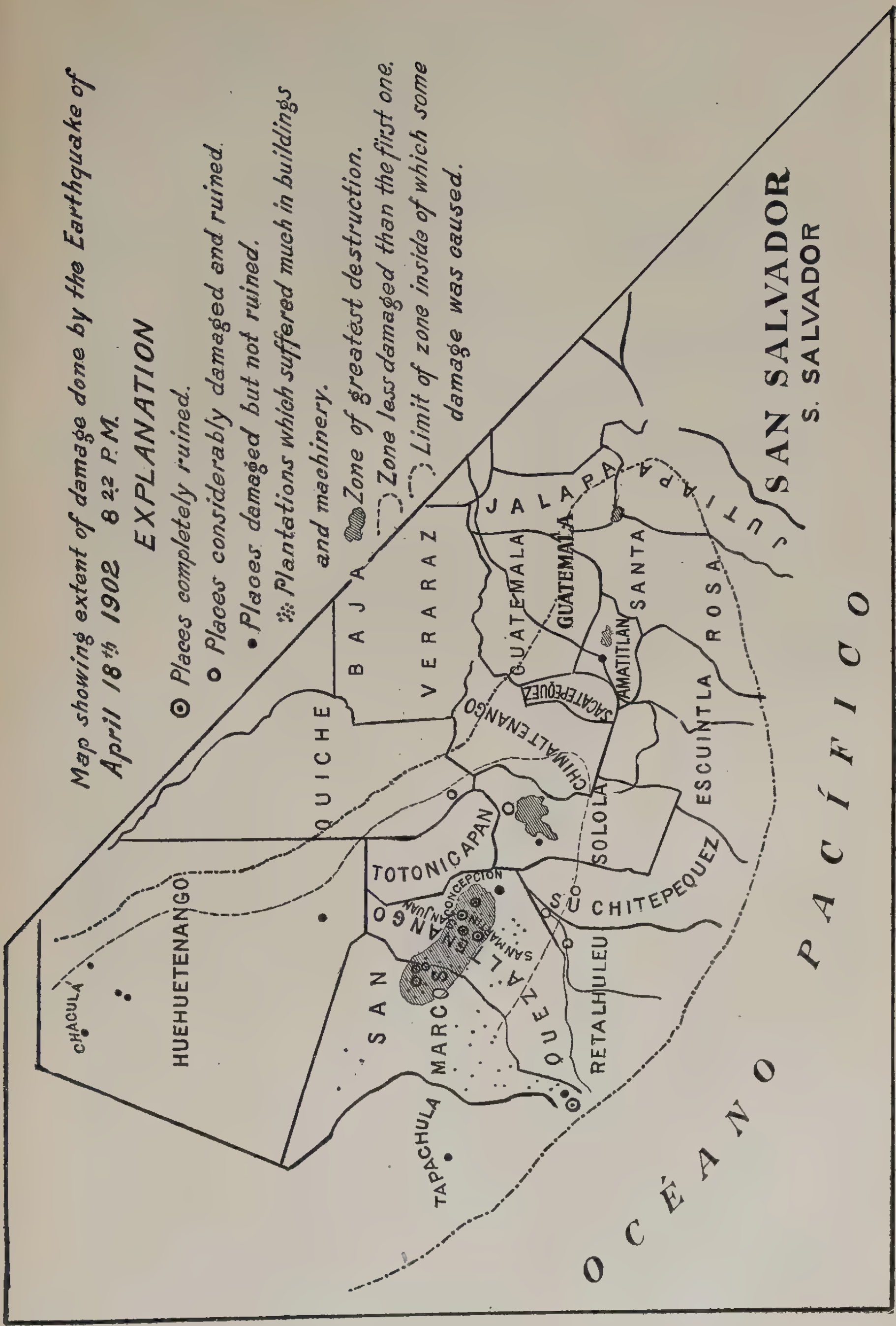
I had just arrived in Huehuetenango the day previous to the earthquake. At half-past eight in the evening of the 18th I was occupied in my room, when, suddenly, the earth began to tremble. I rushed out into the open courtyard, and was immediately joined by everyone in the hotel. The movements lasted three minutes, at first gentle, then increasing to a maximum, then declining. During the night there were smaller shocks, and others next day. These shocks were renewed in the night, and there was one tremor which lasted for fifteen minutes. This was heavy enough to cause the telephone poles to swing perceptibly for that length of time. Standing in the yard and facing the east, I could observe the swaying of our low house, the wall of which was not over 8 feet high. It appeared as if the house stood in a heavy swell of waves. There was heard only a low creaking of walls. The air was filled with dust from the fall of the church tower and a house near by, and much other damage was done. Every house in town was cracked more or less seriously. All the roofs settled, and some fell. The large tower of the Government building, square in shape, about fifty feet high and twenty feet at the base, was greatly injured, the upper part twisted so that it did not stand in line with the lower. The churches were more damaged than other buildings.

The effect of the earthquake was felt over the whole of Central America, but especially in Guatemala, Salvador, and the southern half of Mexico. The centre of destruction seems to have been in the vicinity of Quezaltenango, extending towards San Marcos. The general opinion was and is that the wave of disturbance came

from the ocean, and that the centre of the earthquake lay some hundreds of miles out in the sea. There is really nothing to indicate that the wave came from the ocean, but every reason to presume that its centre was near the centre of the greatest disturbance—that is, between Quezaltenango and San Marcos.

I visited nearly all the places which had been greatly injured. The first reports were that the towns of the western part of Guatemala had all been destroyed. There were only two larger places totally destroyed—Quezaltenango and San Marcos, and, with these, the little villages situated between them. In Quezaltenango about one-half of the houses were ruined beyond repair. These houses were situated in the lower part of the city. The upper part was less injured. All the tall buildings, with the exception of two, were so injured as to be useless, or at least dangerous. The majority of large buildings, of two or more stories, were thrown down. In many the upper story fell, while the lower remained. I was informed that only 260 persons were killed in Quezaltenango, and that altogether only some five hundred persons had been killed; but it is probable that at least 1,500 were killed in the Republic by the first shock.

In San Marcos the destruction was, if possible, greater. In the smaller villages, where the houses are made of adobe and straw, only the former were injured. All the churches in those villages, in the vicinity of San Marcos and Quezaltenango, were thrown down, only a few walls or parts of wall remaining. This destruction to churches extended over a large part of Guatemala, but especially in the western and northwestern part. There were some exceptions. For instance, in Totonicapan little damage was done. This was also the case in Quiché, where not even a house, church, or Government building was injured. But in Santo Tomas Chichecastenango, situated near Totonicapan and Quiché, the church was practically destroyed, while the adobe houses were injured by cracking. Even in the northern part of Huehuetenango district the churches were injured or destroyed, as, for instance, in San Martin, Soloma, etc. But as we go further north the damage was less. Salcachá is situated only two leagues from Quezaltenango, but it remained uninjured. The comandante telegraphed to the President that the town had been totally destroyed; but I failed to find a single house that had suffered seriously, and even the church was only slightly injured. This town lies on perfectly low and level ground along the same stream which flows by Quezaltenango. The other uninjured towns, I found, were all situated on table or


Map showing extent of damage done by the Earthquake of
April 18th 1902 8 22 P.M.
EXPLANATION
Places completely ruined.
Places considerably damaged and ruined.
Places damaged but not ruined.
Plantations which suffered much in buildings and machinery.
Zone of greatest destruction.
Zone less damaged than the first one.
Limit of zone inside of which some damage was caused.
CHACULÁ
HUEHUETENANGO
QUICHE
BAJA
VERAPAZ
JALAPA
GUATEMALA
GUATEMALA
AMATITLAN
SACATEPEQUEZ
CHIMALTENANGO
TOTONICAPAN
SOLOLA
SANTA
ROSA
JUTIAPA
ESCUINTLA
SUCHITEPEQUEZ
RETALHULEU
QUEZALTENANGO
CONCEPCION
SAN MARCOS
TAPACHULA
SAN SALVADOR
S. SALVADOR
OCÉANO PACÍFICO

mesa lands, surrounded by deep barrancas or gorges, cut out by creeks or rivers. When these deep gorges were situated between the town and the earthquake centre the town had not suffered. But when, as in the case of Santo Tomas Chichecastenango, there were no barrancas to separate the houses from the earthquake centre, then destruction had taken place. This theory seemed to hold good in every instance, except as regards Salcachá. Thus Sololá was greatly injured; while Panajachel and the other villages on the Lake Atitlan were uninjured, except Santo Tomas, the latter being the only village on the lake which was not separated or protected by a channel in the direction of the greatest disturbance.

The earthquake wave seemed to have a rotary motion. Thus the stones which composed the pillars of the church in Quezaltenango and the stones of some of the pyramidal monuments in the churchyard were twisted in different directions.

On the coast the earthquake caused much damage, but not as great destruction as on the high lands. Thus, almost every coffee plantation had its machinery more or less damaged. Many houses were thrown down, and the cities San Felipe and Mazatenango suffered greatly. The map has been made for the purpose of illustrating the effects of the earthquake.

Much of the damage done to the houses is due to the poor manner of building. The stone used in Quezaltenango is very friable, and can be crushed between the fingers or under the foot. It does not harden with age. It is an andesite rock containing much hornblende, and resembles in texture a very friable sandstone. If the houses had been built of this stone exclusively very much less damage would have been done. But the manner of building is surprising. The stone is in thin slabs, about 18 inches by 6 inches by 8 inches. These stones, which are cut with a knife, are placed on end about three feet apart. In this way two narrow parallel walls are formed. The space between these walls is filled in with mud, pieces of rock, old bricks, etc. This structure then makes up the wall of the new house. The wonder is, not that such walls were thrown down by an earthquake, but that they could support themselves. The only two houses in Quezaltenango which were not injured were built solidly of the same stone. These two houses did not even show a crack from the outside.

I was told that the earthquake opened the ground in many places on the coast. I failed to find such cracks. But on the road from Zuñil to San Felipe a large part of a barranca wall was tumbled down and blocked the road for a long time. On the steep side of

the Volcan de Fuego parts of the cliffs fell along the steep barrancas. I counted some sixty places from below where large parts of the walls had been made to shed their surface covering. In one place a deep barranca had been opened, and vapours were streaming out from the interior of the volcano.

Atmospheric Phenomena accompanying the Earthquake.

There can be no doubt that the earthquake had something to do with the eruption of Santa Maria. The effects of the eruption and the earthquake extended over much of the same territory, and the centres of the two seem to coincide to an extent that could not possibly be accidental. If there had been more towns built of adobe in the vicinity of the crater it is probable that we should have found the greatest destruction of property nearer the volcano than Quezaltenango.

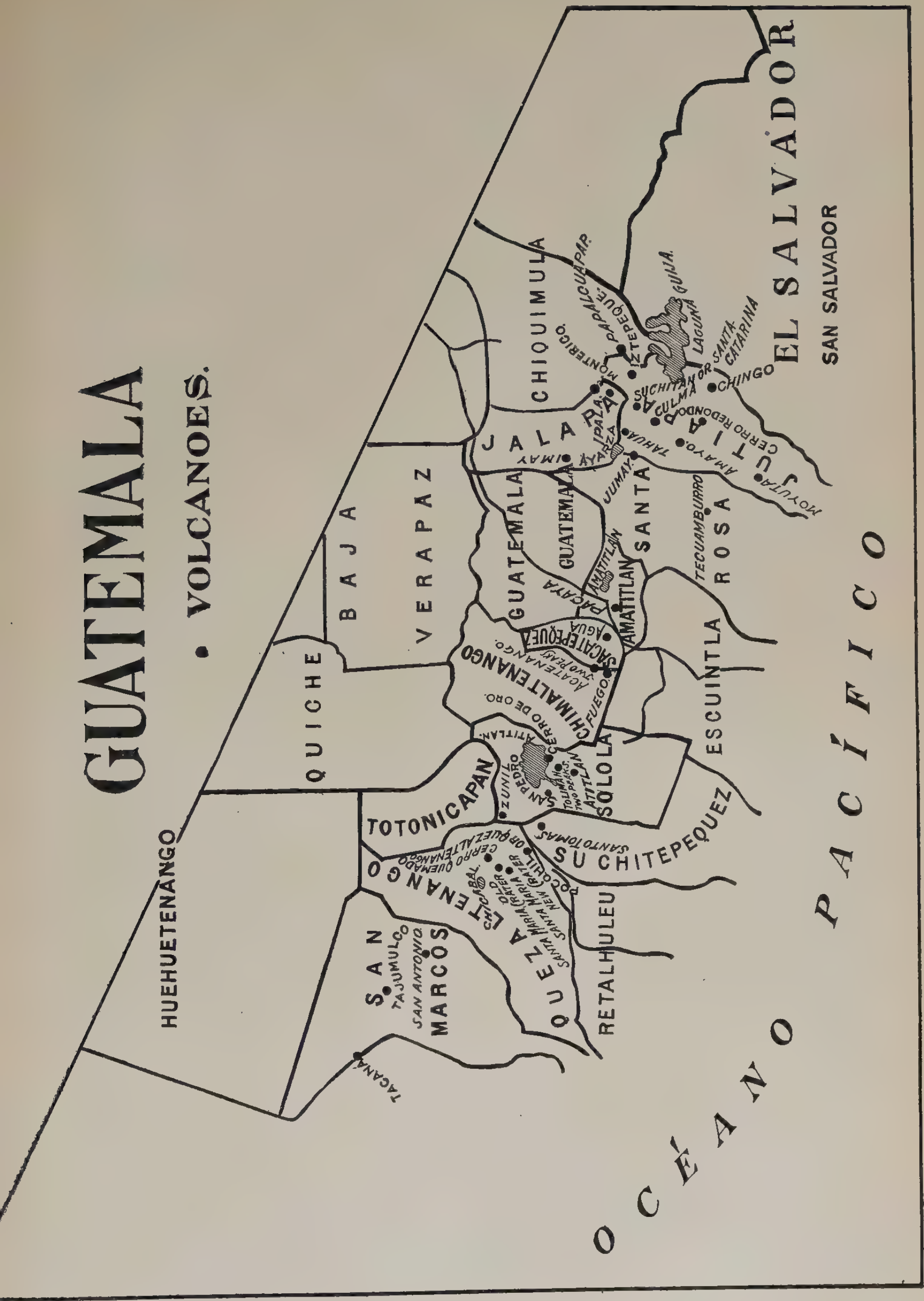
An interesting phenomenon in connection with the earthquake was the sudden cessation of rain. The regular rainy season had already set in some weeks before the earthquake, and for days before there had been rain every afternoon. But the very moment the earthquake took place the sky cleared up and there was no rain for three weeks or so. If this is not a pure coincidence, it will appear as if the earthquake was actually connected with a disturbance in the atmosphere, possibly one of electric nature, the early storms being electrical storms.

If, on the other hand, my observation that the effect of the earthquake was modified by the surface obstruction in the way of barrancas or gorges is not the result of coincidence, then it would show that in this instance, as in many others, the earthquake movement had been confined to the surface of the ground, and that it might possibly have originated through some electrical disturbance near the surface of the earth.

The Volcanoes.

The volcanic rocks in Guatemala appear to be comparatively recent, probably not later than the Cretaceous period; while the majority was ejected during Tertiary times. At the beginning of the eruptive age a large fissure appeared along the Pacific coast on a line now marked by the crest of the cordillera. Outside of this line no volcanic phenomena have left vestiges in Guatemala, as along the north and the northeast side of the Republic no traces are found of recent eruptions, and consequently of no eruptive cones. Beginning close to the boundary of Mexico, the traveller

may observe from the steamer a succession of volcanic peaks, which constitute the most characteristic, as well as the most interesting and beautiful, features of Guatemala. The one situated nearest the Mexican boundary is Tacaná, also known as Soconusco. The next in order to the southeast is Tajumulco, incorrectly called Tajumulto. This volcano, like Tacaná, presents the appearance of several broken cones. Then comes Santa Maria, the Indian name of which is Excanul. The main cone of this beautiful volcano is a perfect pyramid, from whatever side it may be seen. As appendices to this volcano must be considered the smaller eruptive craters of Cerro Quemado and possibly the Zuñil, the latter situated immediately to the southeast, while the former rises on the north side of the main cone of Santa Maria. To the east of Zuñil a smaller and irregular cone bears the name of Santo Tomas; while another in the same vicinity is known as Santa Clara. Immediately south of these volcanoes rises the regular and perfect cone of San Pedro. Next in order, and very close to San Pedro, we see the dominating pyramid of Atitlán, one of the highest volcanoes of Guatemala. On the same base as Atitlan, but hidden from the coast, are two smaller volcanoes, the larger being Toliman, with two peaks, while the smaller is known as Cerro de Oro. The latter, a very diminutive but nevertheless very perfect crater, is situated at the base of Toliman, at the very shore of the Lake Atitlan. Some thirty miles to the southeast we find the highest and most famous of the Guatemala volcanoes. The nearest one is Fuego; while adjoining, on the north side of the latter, lies the even higher Acatenango, the two rising from the same base. Separated from Acatenango by a small valley lies the majestic "Volcan de Agua," the handsomest and most regular of all the volcanoes of Central America. A short distance southeast of Agua we observe the five irregular cones of the volcano Pacaya. By following the main eruptive fissure down the coast we reach finally the volcano Tecuamburro, and further on the volcano Moyuta. The best-known volcano in this vicinity is, however, Chingo, situated on the very boundary of Salvador. All the above volcanoes, except Chingo, are situated on the main fissure, which forms the principal crest of the cordillera. North of the main fissure there exist others, the relative positions of which are not so well defined. On a short side fissure parallel with the main one we find the volcanic cones of Jumay, Cuema, Amayo, and Chingo; while Suchitán, Tahua, Papalcuapa, Iztepeque, Monterico, and Ipala seem grouped along a fissure almost running at right angles with the former. The most inland volcanoes are Imay,


GUATEMALA
• VOLCANOES.
HUEHUETENANGO
QUICHE
BAJA
VERAPAZ
TOTONICAPAN
SAN MARCOS
QUEZALTENANGO
RETALHULEU
SUCHITEPEQUEZ
SOLOLA
CHIMALTENANGO
SACATEPEQUEZ
ESCUINTLA
AMATITLAN
GUATEMALA
SANTA ROSA
JALAPA
JUTIAPA
CHIQUIMULA
EL SALVADOR
SAN SALVADOR
OCÉANO PACÍFICO
TACANA
TAJUMULCO
SAN ANTONIO
AGUA
FUEGO
ACATENANGO
PACAYA
TECUAMBURRO
MOYUTA
CHINGO
LAGUNA GUIJA

situated about midway between Ipala and the city of Guatemala, and the volcano Ticanlu, which rises about thirty miles to the northeast of Ipala. All the western volcanoes from Tacaná to Agua consist of andesite rock. The eastern group, including Pacaya, consist of basaltic rocks, except Iztepeque, which, according to Rockstroh, is made up of obsidian or volcanic glass.

As volcanic craters we must also consider the large lakes situated immediately north of the main fissure. These lakes are, beginning with the most westerly one, Chicabay, Atitlan, Amatitlan, Ayarza, and Guija, the last partly situated in Salvador. What yet remains of the crater walls surrounding these lakes indicates that they once formed part of a chain of craters of basaltic nature, which rose on a fissure of very ancient origin. The width of the fissure was probably about eight or ten miles; while the length extended from the northern boundaries of Guatemala far beyond the borders of Salvador. Of these crater lakes the Atitlan is the one which has best preserved its original nature and form. The side walls of the lake are precipitous, especially on the northern shore, where a narrow band of debris separates the crater wall from the shore-line. The origin of Amatitlan is less apparent, and Dr. Ed. Rockstroh is inclined to consider this lake as having been formed by the rising of the volcano Pacaya. But to my mind the similarity of the two lakes is so great that it is impossible to ascribe them to different origins. Even in Amatitlan we have the precipitous crater walls on the northern sides—walls made up of basaltic rocks, like those of Atitlan. The most important characteristic of these lakes, indicating their volcanic nature, is that we can trace from them ancient lava-flows in the direction from the former summits to the present coast. These lava-flows consist of the same basaltic rocks as the craters of the lakes, and could not possibly have originated from the andesite volcanoes in their present form. This leads us to a consideration of the respective ages of the Guatemala volcanoes and the formation of the fissures.

Altitude of the Volcanoes.

The altitudes of the andesite volcanoes of Guatemala are variously given. In the geographies published in the country these altitudes are greatly overestimated, sometimes by as much as three thousand feet or more. The following list has been prepared from measurements made by the International Railway of Guatemala, by Dr. C. Sapper, by Prof. Eduardo Rockstroh, from measurements

with an aneroid by the author, and from the U. S. Government charts: *

Agua, top	12,988 feet.	Sacatepequez.	I. R.
Agua, crater	12,543 feet.	Sacatepequez.	G. E.
Amayo	3,444 feet.	Jutiapa.	C. S.
San Antonio	8,364 feet.	San Marcos.	C. S.
Atitlan, crater lake	4,425 feet.	Sololá.	G. E.
Atitlan	11,600 feet.	Sololá.	I. R.
Cerro Quemado, top	10,427 feet.	Quezaltenango.	I. R.
Cerro Quemado, crater	10,400 feet.	Quezaltenango.	G. E.
Cerro Redondo	4,155 feet.	Santa Rosa.	C. S.
Culma	3,445 feet.	Jutiapa.	C. S.
Chingo, top	5,840 feet.	Jutiapa.	I. R.
Chingo, crater	5,447 feet.	Jutiapa.	C. S.
Fuego, top	12,603 feet.	Sacatepequez.	U. S. Ch.
Ipala, top	5,477 feet.	Chiquimula.	C. S.
Ipala, crater	4,952 feet.	Chiquimula.	C. S.
Iztepeque, top	4,464 feet.	Jutiapa.	C. S.
Imay	7,216 feet.	Jalapa.	C. S.
Jumay	5,936 feet.	Santa Rosa.	C. S.
Lacandon	9,217 feet.	San Marcos.	I. R.
Santa Maria or Excanul	12,467 feet.	Quezaltenango.	I. R.
Monterico	4,329 feet.	Jalapa.	C. S.
Moyuta	5,525 feet.	Jutiapa.	U. S. Ch.
Moyuta, crater	5,280 feet.	Jutiapa.	C. S.
Papalguapa		Jutiapa.	
Pacaya, top	8,500 feet.	Amatitlan.	I. R.
Pacaya, crater	8,245 feet.	Amatitlan.	C. S.
Pocohol	9,330 feet.	San Marcos.	U. S. Ch.
San Pedro	9,917 feet.	Sololá.	I. R.
Suchitán	6,516 feet.	Jutiapa.	I. R.
Tacaná	13,329 feet.	San Marcos.	I. R.
Tahua		Jutiapa.	
Tajumulco, top	13,800 feet.	San Marcos.	I. R.
Tajumulco, crater	13,288 feet.	San Marcos.	C. S.
Tecuamburro, first top	6,064 feet.	Santa Rosa.	I. R.
Tecuamburro, second top	6,383 feet.	Santa Rosa.	I. R.
Tecuamburro, crater	4,723 feet.	Santa Rosa.	C. S.
Tolimán, southern top	10,341 feet.	Sololá.	I. R.
Tolimán, northern top	10,266 feet.	Sololá.	C. S.
Zuñil, top	11,522 feet.	Quezaltenango.	I. R.

Comparative Age of the Volcanic Fissures and Craters.

The very oldest fissure is undoubtedly the one on which are situated the crater lakes just referred to. It probably opened during the early Tertiary period. The trend of this fissure diverged more towards the east than the present coast-line, ending in the

* The initials indicate the authorities, the names Sololá, Jutiapa, etc., the Departments.

large lake of La Guija. The early craters were of gigantic nature and much larger than the later volcanoes, though inferior to them in height. From these craters flowed large lava rivers, also made up of basaltic rock fluid. The remnants of these basaltic rivers are yet to be seen in the form of numerous fantastically-shaped hills at the base of the present volcanoes, as will be presently mentioned more in detail.

After the first eruptive force of these basaltic craters had spent itself a long period of inactivity followed, during which the coast-line was gradually rising. At the end of this period, probably during the middle Tertiary, a new fissure opened along the south side of the old craters. Along this fissure opened the present andesite volcanoes extending from Tacaná to Agua. Of these more modern craters those situated most inland are, as a rule, the oldest, this being generally the case where two or more craters are situated close together on the same base. Thus we know that Fuego is younger than Acatenango; and it is probable that Atitlan is younger than Tolimán. But Cerro de Oro seems younger than both Atitlan and Tolimán, if we may judge from the preservation of its crater. From the present eruption of the new crater of Santa Maria, the San Antonio, we know that here also the new force has exerted itself towards the Pacific shore-line. Exception to this rule is the modern crater of the volcano of Quezaltenango, generally known as the Cerro Quemado. This crater opened in 1785, and at a time when Santa Maria was considered as an entirely extinct volcano.

Of the first eruptions of basaltic nature, probably from the present lakes of Amatitlan and Atitlan, there yet remain large dikes, which form a prominent part in the Guatemala coast landscape. Rising from the level slope just below the cordillera, at an altitude of about 1,500 feet, we find a series of low, precipitous hills and ridges, which, with their black, castellated rocks, stand out imposingly against the verdant slopes of the volcanoes. At first it would appear as if these ridges formed a more or less continuous belt parallel with the cordillera, but upon a closer examination this is found to be incorrect. We can follow these "peñascos" from the boundary of Mexico to that of Salvador. They rise abruptly from the plain, and are found to be in groups. The crests are often fantastically shaped, and in many instances bare of vegetation on account of their almost perpendicular sides. On the maps of the country these peñascos are nowhere marked, and in order to get a good view of them it is necessary to examine them from some altitude, preferably from the volcanic slopes. It will then be seen that,

instead of being strictly parallel to the cordillera, they actually form with it various angles, and in some instances branch out in a fan-shaped manner from the general summit of the cordillera to the plain below. This is plainly observable as regards the peñascos below Atitlan and Amatitlan, as well as those on the coast of Costa Cuca below Santa Maria and Tajumulco. As these peñascos are made up entirely of basaltic rocks, similar to those forming the walls of the two large crater lakes, etc., the only explanation of their nature is that they are remnants of the old lava-flows from the first basaltic craters in Guatemala. They can be traced from an altitude equal to that of the present crater lakes to a line drawn from below Escuintla to San Felipe—a line running parallel with the cordillera. Below this line these basaltic flows do not seem to have passed; and it is probable that at the time of their flow the ocean reached to their very base, whereas it has now receded some thirty miles below them. It is evident from the great erosion which has taken place that a very long period elapsed between the formation of these peñascos and the rising of the andesite volcanoes. The land had already then been sufficiently eroded to make it impossible for the more recent lava-flows to cover the older basaltic flows, the former simply passing by the latter. Another point of interest is that all the basaltic flows took place towards the present coast, indicating that the present continent had already risen to a great elevation long before the basaltic eruption took place.

Of the age of the eastern volcanoes little is known, and even their exact location is not marked on any map with accuracy. It seems probable that they are intermediate between the old basaltic flows and the andesite volcanoes. The volcano Pacaya seems to belong to both classes. The oldest eruptions of Pacaya consisted of basaltic rocks; while the many modern eruptions in historic times have projected both andesite lava and loose sand and ash.

Of the interior volcanoes grouped in the vicinity of Lake Guija none has been in eruption in modern times.

Eruptions in Historic Times.

According to a list communicated by Dr. Eduardo Rockstroh the historic eruptions are as follows:

YEAR.	NAME.	INTERVAL IN YEARS FROM PREVIOUS ERUPTION.	INTERVAL IN YEARS FROM LAST ERUPTION.
1526.	Fuego..................		
1565.	Pacaya..................		39
1581.	Fuego..................	55	16
1582.	Fuego..................	1	1
1585.	Fuego..................	3	3
1586.	Fuego..................	1	1
1614.	Fuego..................	28	28
1623.	Fuego..................	9	9
1651.	Pacaya..................	86	28
1664.	Pacaya..................	13	13
1668.	Pacaya..................	4	4
1671.	Pacaya..................	3	3
1677.	Pacaya..................	6	6
1686.	Fuego..................	63	9
1699.	Fuego..................	13	13
1705.	Fuego..................	6	6
1706.	Fuego..................	1	1
1707.	Fuego..................	1	1
1710.	Fuego..................	3	3
1717.	Fuego..................	7	7
1732.	Fuego..................	15	15
1737.	Fuego..................	5	5
1775.	Pacaya..................	98	38
1785.	Cerro Quemado..........		10
1799.	Fuego..................	62	14
1829.	Fuego..................	30	30
1855.	Tacaná..................		26
1855.	Fuego..................	26	0
1856.	Fuego..................	1	1
1857.	Fuego..................	1	1
1880.	Fuego..................	23	23
1902.	Santa Maria.............		22

It will thus be seen that there has been no great regularity in the eruptions, and that it is impossible to prognosticate, with hope of correctness, from former eruptions to future ones. The activity has been divided between Fuego and Pacaya. The former has during four centuries erupted twenty-two times; while Pacaya comes next in order with seven eruptions. The other three volcanoes mentioned have each but one. The following are the intervals in years between the eruptions of Fuego since 1526: 1, 3, 1, 28, 9, 63, 13, 6, 1, 1, 3, 7, 15, 5, 62, 30, 26, 1, 1, 23. Of Pacaya, the intervals have been similarly as follows: 86, 13, 4, 3, 6, 98.

If we consider the eruptions as a whole we find that the long periods of inactivity of both Fuego and Pacaya have been broken by eruptions of the one during the inactivity of the other. At no time has there been any interval of inactivity for more than thirty-nine years; while there have been eruptions in consecutive years, and twice two eruptions in the same year. Judging the future by the

past, we may say that we should not expect any period of inactivity to last longer than forty years, and that from six to twelve eruptions may be expected every century. The long periods of inactivity seem to occur about once in a century. It would also appear as if the longer intervals were succeeded by numerous smaller ones. In that case we may during the next few years expect eruptions of some volcanoes, presumably Fuego and Pacaya.

The Eruption of Santa Maria.

The 24th of October, 1902, I had just arrived at Rabinal. During the night I was awakened by what I considered to be heavy cannonading or firing of bombs. As there was to be the "Fiesta de Minerva" celebrated simultaneously in all towns and villages in Guatemala the following day but one, I naturally presumed that the festivities had begun. When I arose at daybreak I was informed that the celebration had not commenced; that the general opinion seemed to be that the cannonading proceeded from the city of Guatemala. The first outburst of the supposed firing was heard by myself about eleven o'clock at night between Friday and Saturday, October 24th and 25th. Towards morning the explosions increased in force, and continued all through the day with intervals of from one to ten minutes. Towards evening the explosions had become more loud and more frequent, and, beginning with 4.30 P.M. and continuing towards 6.30, the noise was intense and the explosions almost continuous. Already in the morning I was satisfied that one of the volcanoes had erupted, and I accordingly forwarded a telegram to my agent in Guatemala City to find out which one. The answer came only towards evening, being a negative one, as the Government prevented the circulation of news. In the forenoon I ascended the highest hill near the town, hoping to see something. The noise from the explosions was here more intense than in the valley, and the ground trembled at every detonation, when towards sunset the explosions increased in violence and it seemed as if the hill on which I stood was ready to burst. At times I had to lay hold on the rocks in order not to be thrown down, and I descended shortly after dark.

As, however, the trembling of the ground was so much less below I became satisfied that an eruption had taken place from one of the volcanoes near Quezaltenango, probably El Zuñil. Santa Maria itself had never been in eruption, and Cerro Quemado had not shown any life for one hundred and seventeen years. In the meantime a telegram had been received from the "Supreme Govern-

ment" stating that one of the volcanoes "in Mexico" had broken out and that there was no cause for alarm. This statement was not believed by any one, as the explosions came from an entirely different direction. I started the following day for Quezaltenango, but the mountain roads had become impassable through washouts [it was the middle of the rainy season], and I had to take the roundabout way over Salamá and Chimaltenango, instead of the more direct one over the mountains and Quiché. Already next day I could see from a high mountain top the immense columns of smoke, and I was able to determine that the eruption was near Santa Maria. The top of this volcano stood out against the clouds, and I presumed that the smoke issued from the mountain known as Siete Orejas, which, however, was not the case. Through one delay or the other I did not arrive in the vicinity of Santa Maria for several days. It was impossible to proceed down the coast, and I had to return to Guatemala and take the steamer to Retalhuleu in order to visit the coast region destroyed, or greatly injured, by the eruption. The following account is based upon my own observations, but I have incorporated some accounts given by one or two friends who happened to be near the volcano during the first few days of eruption.

The 24th of October, 1902, at 6.30 in the afternoon, there were suddenly heard all over Guatemala, Salvador, and the southern part of Mexico and Yucatán heavy *retumbos*, or underground explosions, so common in volcanic countries. In Mexico these *retumbos* were heard as far as Tehuantepec. In Guatemala they were heard all over the Republic, and in Flores, the capital of the Department of Peten, they sounded like heavy cannonading in the direction of Guatemala. The distance to which the sound of the explosions reached appears to have been about 400 miles, more or less. Every explosión caused heavy tremblings of the ground for at least 250 miles from the centre of the disturbance, and this trembling was much greater in the higher elevations than in the lower ones. While thus distinct on the lower plains around Salamá and Rabinal they became alarming when one ascended any of the surrounding hills. But even in the immediate vicinity of the volcano these tremblings did not take the form of earthquakes, and no damage was caused from them alone. They occurred after every explosion, and seemed to travel as fast as the explosion itself. It could be distinctly felt that they came from the same direction as the sound while one was upon the plain, but on the top of the hills the trembling movement seemed to come from the opposite direction or from beneath the ground. In the vicinity of Santa Maria these *re-*

tumbos were intensified and re-echoed from the volcano Tajumulco, so that it was almost impossible to decide upon their origin. At the time of the first *retumbos* Santa Maria was covered by a dense mantle of clouds, which was mistaken for the usual bank of rain-clouds. At about 2 A.M. on the morning of October 25th the trembling of the ground suddenly increased to such an extent that few people remained in their beds.

In Quezaltenango, situated on the northern side of Santa Maria, it was impossible to decide upon the direction of the *retumbos*, nor could any phenomenon of light be observed; but on the west side of the mountain one could clearly see, six miles away, flashes of light. These flashes of lightning extended as far as Tajumulco, and it appeared as if both volcanoes were in eruption. Later in the night, when these flashes were also seen in Quezaltenango, it seemed as if they came from the mountain known as Siete Orejas. For more than a week the people in the vicinity of the new crater did not know its location; and in the city of Guatemala, as well in the Republic generally, the place of the new crater was not known for several weeks.

At midnight, October 24–25, the obscurity caused by the cloud from Santa Maria to Tajumulco became intense, and at about 2 A.M. a fine ash began to fall over the district surrounding Santa Maria. About 9 A.M., on October 25th, the ashes changed into heavy sand of a grayish-white colour, this fall being much heavier in some places than in others. At daybreak, the 25th, there was absolutely no sign of daylight, and for a distance of 25 miles to the north, west, and south of the volcano it was necessary to use candle-light throughout that and several of the following days. With the evening of the 25th the *retumbos* diminished in frequency and intensity, and after this time they could not be heard for more than about 100 miles from the volcano. The rain of sand continued for about thirty hours, and was succeeded by a fall of mud. This began early October 26th, and continued until 6 P.M. the same day. This fall of mud did not extend as far as the fall of sand and ashes, but confined itself to a radius of 12 miles in every direction. After the fall of mud had subsided, the fall of fine sand, or rather ashes, continued throughout the days of 26, 27, 28. In the evening of the 28th the light of day began to appear, and the sky cleared to such an extent that during the night some stars became visible. On October 30th the sun could be seen through the reddish clouds of smoke, and, at the same time, it became possible to observe the eruption of smoke-clouds from the new crater. It was then seen

that, though the eruption had diminished, enormous clouds of smoke and vapour ascended to a height of about 10,000 feet above the crater and masses of ashes were thrown out about 15 miles to the west. As late as November 8th ashes fell over a district about 20 miles to the west and southwest; but the fall was light, and no further damage was then done.

During all this time the *retumbos* continued, but at longer and longer intervals, both day and night. At the end of November they had become rarer, but were heard every day. When I left Aurora, about five miles from the crater, on November 1, the noises were yet loud enough to cause much alarm, and every one was fearing a new eruption.

The electric phenomena accompanying the eruption of Santa Maria were most marked. On the 25th October, from 12 noon to 5 P.M., a sudden and most terrific hurricane swept the vicinity of Santa Maria, extending from several miles southeast of the volcano to several hundred miles west and southwest. During this time the lightning struck the ground continually, and, judging from a trip over the country after the eruption had subsided, I am inclined to think that there was not an acre that had not been struck by lightning within the territory swept by the hurricane. How far this extended north and westwards I do not know. But southwards and southwestwards I saw, for fifteen miles from the crater, trees everywhere destroyed by lightning. Branches were twisted and broken, and trunks had fallen to such an extent that progress through the woods was impossible except on foot.

While this tremendous hurricane lasted only four hours it did more damage than all the other phenomena of the eruption. It was during this time that most of the mud fell, and that all the trees for a hundred miles to the west of the volcano were stripped of their leaves.

The direct electric phenomena of the eruption consisted of flashes of lightning. From the clouds above the volcano crater a constant rain of lightning streamed down to the rim of the crater as well as to the tops of the surrounding mountains, especially to Tajumulco. These lightnings were of various colours, varying from red, pink, and violet to greenish blue.

During the night of October 24, and the day of October 25, within a radius of fifteen miles of the volcano, at short and varying intervals, electric flames or prolonged sparks were seen to ascend from the ground into the smoke and ash-filled air. These flashes had the appearance of actual elongated, narrow flames of pale violet

light, at times changing to yellowish. They proceeded from the soil in the streets, or from the open places, and reached ten or more feet in the air. There was no sound and no crackling noise, and most people supposed them to be incandescent gases ascending from the ground. In the *fincas** on the slope of the volcano I was told that when people walked on the verandas of their houses where ashes had fallen electric sparks accompanied by crackling noises would appear between their feet and the ground.

During the first four days of the eruption no view could be had of the rising crater-cloud from the immediate vicinity of the volcano. Only at a distance of forty miles to the north and east could the erupted sand and smoke be seen against the sky. The first view I had of the eruption was on the fourth day, from the hill of Vuelta Grande, and during the night-time. I could then see plainly rising from a smoky sky a dense illuminated cloud, through which flashed lightnings by the dozen in every second. Rising upwards and outwards, in the way water is thrown out of a fountain-jet, there was an almost continuous display of fire balls, which burst and threw out reddish stars.

Two days later I had another opportunity to view the eruption from a distant hill under a clear sky, and in the day. The appearance was then as follows: The peak of Santa Maria was sharply delineated against the sky. To the westward or oceanward of this pyramid rose every few minutes immense masses of globular clouds, like steam and smoke thrown out of a locomotive when it first starts. These clouds rose to a height of 20,000 feet above the crater in three or four seconds. About every five minutes the whole cloud mass was suddenly pushed to the westward, being carried over the lowlands of the coast and, probably, also northwest towards the Mexican boundary. At intervals of from a few seconds to several minutes new globular masses of clouds shot upwards from the crater, reaching the same high altitude in an incredibly short time, only again to be carried towards the ocean in the same way as at first. These cloud-masses were all white, and resembled thunder-clouds. Besides these quickly-ascending clouds there was seen a continuous reddish-yellow stratum resembling smoke, which must have been about one thousand feet in thickness and horizontally spread out at an altitude of about nine thousand feet, or about three thousand feet below the top of Santa Maria. This cloud reached east and west about twenty miles on each side of the crater. This view was had at 9 A.M. At 2 P.M. streaks of what appeared

* Farms or properties.

to be rain descended from the white cumulus clouds which every now and then rose from the crater, but from the red cloud nothing seemed to fall; it remained motionless as a stratum of reddish smoke over the land surrounding the mountain.

At the end of November, or about a month after the first eruption, I had opportunity to watch the daily eruption of clouds from the crater, especially from the hill of Aurora, on the west side of the mountain and about five miles in a direct line from the crater. This view could only be had in daytime, and then only at from 6 to 8 o'clock in the morning, after which hour the sky would cloud up so that neither the pyramid of Santa Maria nor any other part of the cordillera could be seen. Eruptions were observed only during the morning; but the general belief was that the crater erupted regularly twice a day, morning and afternoon. The fact that the volcano could never be seen in the middle of the day and in the afternoon made any reliable observation impossible; and I think it probable that the eruption continued day and night. At intervals of from a few seconds to ten minutes at the longest, columns of white smoke rose with great force from the crater. It could be clearly seen that they came from at least six distinct openings. At times six columns could be seen issuing at the same time, while a few minutes later there might be only one or two columns. At times these columns coalesced at a height of a few hundred feet; at others they remained separated to a height of two or three thousand feet. At a height of about five hundred feet above the crater, part of the issuing clouds separated from the rest, and were gradually carried along the crest of the cordillera up the coast. In this manner was formed a horizontal continuous stratum, a few hundred feet thick, but ten to fifteen miles long, extending principally in one direction, up the coast or northwestwards. The other globular clouds dissolved when reaching an altitude varying from three thousand feet to five or more thousand feet above the crater. Both the rising and the horizontal clouds were of the same whitish hue, only here and there could be seen a yellowish tint in the horizontal cloud. The issuing of the clouds at that late period after the main eruption was not accompanied by retumbos or explosions, but there were heard roaring noises, which made the earth quiver for miles. At intervals of several hours there were regular retumbos, especially in the night-time. Small shocks of earthquake took place every few days. The prevailing winds which carried the clouds away were from east to west.

From the middle to the end of November I made a more

thorough examination of the region along the coast, between Retalhuleu and Santa Maria.

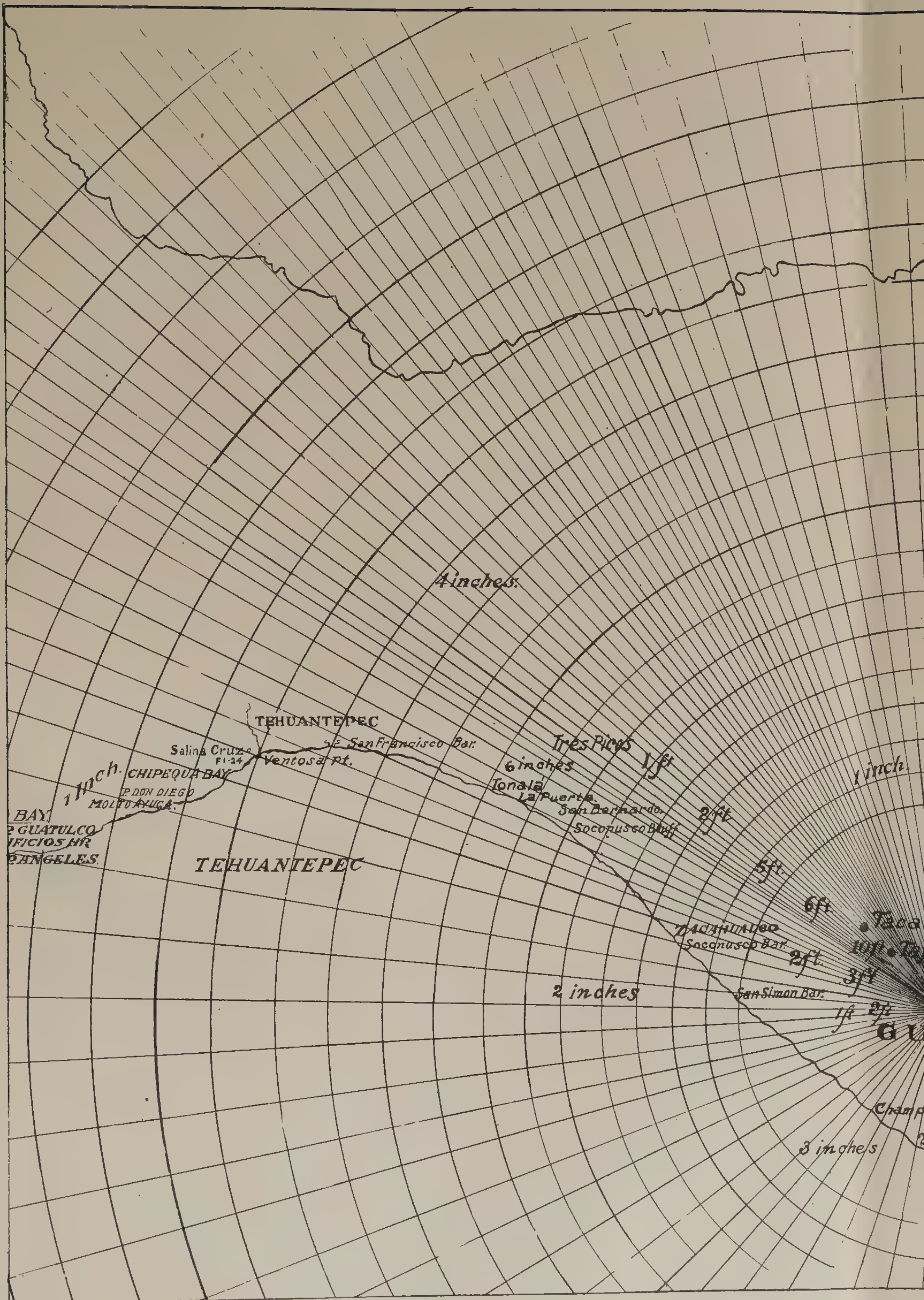
For two weeks after the eruption clouds continually hid the mountain side, but after the worst of the eruptions had ceased it was found that a new crater had opened on the southwest side of Santa Maria at an altitude of about 7,000 feet. The crater is situated immediately below the main top of Santa Maria, on a line drawn between the summit and the nearest point on the coast, and on land belonging to the finca San Antonio, so far as known. The mouth of the crater is an ellipse with the longitudinal axis running almost due east and west for about three thousand feet. The general depth of the crater is about 800 feet; while the deepest part of the crater floor is about 2,000 feet. On this main floor there are seen six funnel-shaped apertures, from which clouds of steam and sulphurous vapours constantly issue. The largest of these fumaroles is situated close to the eastern rim of the crater. It is round, and 100 or 150 feet in diameter. The other fumaroles are near the western rim of the crater. The eastern wall of the crater is nearly vertical, and reaches almost to the very top of Santa Maria. From the sides of the main volcano vast quantities of rocks were constantly falling into the new crater, with a noise resembling thunder. The side thus caving in has a depth of about 6,000 feet, and it so nearly reaches the summit that it seems likely the top cone of Santa Maria will fall into the new crater. If this happens the regular beautiful top will be replaced by two or more broken cones, like those of Pacaya and Tajumulco. Undoubtedly the largest part of the side fell in during the first days of the eruption. What has since fallen forms a cone at the bottom of the crater about 400 feet high and twice as wide. In this cone, resting against the side of the mother volcano, there is situated the sixth fumarole. The deepest part of the crater is towards the east. Towards the centre the crater bottom rises several hundred feet, but sinks again to the westward. All around the crater is a line of rocks about 800 feet wide, the rocks being partly buried, but projecting sometimes sixteen feet above the surface. The upper part of the crater consists of rocks and heavy sand; while the lower part consists mainly of light pumice-stone ash. The inner slopes of the crater form a declivity of about 60 degrees. These notes about the inner appearance of the crater are principally from a memorandum communicated by Mr. Fred. Lenzinger, who, some time after the eruption, visited the crater with two other gentlemen.

Up to the end of November the new crater had not thrown out

any lava, nor any direct streams of water. The eruption had been exclusively of sand, ashes, mud, steam, and sulphurous and other chemical fumes. During the first four days masses of sand and ash had been thrown out in a direction obliquely towards the west and northwest, or parallel to the main axis of the cordillera. Very little had been thrown to the east and south. I found the whole country covered with a thick mantle of white and gray sand. Of the tropical and impenetrable vegetation which once clothed every inch of ground which had not been previously cleared for plantations nothing was left except bare trunks and branches. As far as the eye could reach, beginning about 25 miles from the shore-line and extending to the very crest of the cordillera, was seen a continuous whitish sheet of sand, only shaded by innumerable bare trunks of trees. Here and there could be seen openings in these bare forests; these were the places where the plantations of coffee and sugar-cane had been located.

The whole country appeared exactly like a northern landscape in winter time and after a heavy fall of snow. Nothing green, nothing that would indicate the tropics, nothing that would show that the air was moist, that the temperature was high, that daily rains were thoroughly soaking the ground. The fall of the sand has been very different in different places. Along the base of the crater it had covered everything for miles around with a sheet of sand and mud about 60 feet thick. The nearest plantations were so completely hidden that it was not possible to locate the former houses. Ravines had been filled up and hollows had been levelled, while in other places immense hills had been formed by the erupted sand. In that vicinity only the larger trees could be seen above the sand sheet. Everything else was hidden below. As we proceeded farther away we found that the fall had been less, and at a distance of six miles from the crater the sand lies only from four to six feet deep, but the fall is not even. The deepest fall has been along a belt some five to six miles wide, extending from the crater hundreds of miles to the northwest, thus taking in the high upper slopes of the cordillera, but diminishing rapidly both towards the ocean and towards the interior. The extent of the fall of sand I have endeavoured to show in the map from my own observations and the reports of others. The farthest limit to which the erupted sand reached seems to have been about two hundred miles; while the lighter ashes reached as far as Acapulco and Merida, or about 550 miles.

A most striking feature of the country was the countless ditches


4 inches.
TEHUANTEPEC
Salina Cruz
San Francisco Bar.
Ventosa pt.
Tres Picos
1 ft
6 inches
Tonala
La Puerte.
San Bernardo.
Socopusco Bluff
2 ft
1 inch.
1 inch.
CHIPEQUA BAY
P. DON DIEGO
MOITO AYUCA.
BAY
GUATULCO
TEHUANTEPEC
5 ft.
6 ft
Soconusco Bar.
10 ft
2 ft.
3 ft
2 inches
San Simon Bar.
1 ft
2 ft
3 inches

or trenches, caused by the torrential rains rushing down from the hills. So furrowed was every part of the surface that we could hardly proceed six feet in any direction without having to pass a trench. The depth of the trenches varied according to location and the depth of the sand. On the slope of the crater cone some of these trenches were one hundred feet deep, not only the sand but also the original ground having been washed away. But at a distance of four or more miles we found no trenches deeper than six feet, while the majority varied from a few inches to several feet. To traverse such a ground was exceedingly laborious, it being a continuous jumping across the thousands of gullies and a continuous crawling up one bank and down another.

The effect of this washing out or early erosion can easily be imagined. Where formerly ran small brooks the bottom between the hills now formed irregular flats, upon which the water had spread as a thin sheet. But the greatest change had taken place in the largest rivers. The rivers Samalá, and Ocojíto had in places completely changed their course, cutting through and overflowing their banks, which had been partly, or even entirely, washed away. In most places the banks had been denuded of their trees for hundreds of yards inland, and the underlying boulders had been laid bare. The river-beds had been deepened some thirty feet, and widened in many places to twice their original size.

Almost every afternoon the rivers rose as much as thirty feet above their former high-water mark, carrying not water, as formerly, but a thick gruel-like mud, consisting of water, sand, ashes, and boulders. The aspect of these terrific torrents sweeping everything before them was something frightful. In the rushing waters were seen a mixture of trees, dead cattle, boulders, sand, broken limbs of trees, the whole roaring with the noise of distant thunder, and it was generally feared that the whole aspect of the river system would be changed, as, for instance, at the mouth of the River Ocos. The general opinion was that this mass of mud was thrown out of some opening in or below the new crater, and was not due to rains. But I am satisfied that this is not the case. Nearly all the barrancas in the upper part of the cordillera had been covered with from six to twenty feet of ashes and sand. If we remember that many of these barranca walls are almost perpendicular, and that daily torrential rains, lasting five or six hours, swept these accumulated masses of sand and ashes down in the former river-beds, we can easily understand that new outlets had to be formed. Much of the matter ejected from the crater consisted of pumice-stone, which,

on account of its lightness, remained on the surface of the flood-waters, and tended to block the narrow outlets of the gulches. To the mud, stones, and ashes, were added masses of broken limbs or trunks of trees, all at times closing the outlets in the barrancas, and backing up the flood-waters high above any former mark. Hundreds of such flood-lakes would then, perhaps, give away at the same time, and with renewed force be carried further down the rivers. As a consequence, all the smaller and most of the larger bridges were swept away during the third and fourth days of the eruption. They were later being replaced by wires strung over the torrents, and one could pass over suspended in a cage. Other bridges were being replaced by hammocks, over which the not too timid traveller could pass.

Nature of the Erupted Material.

The nature of this material differs somewhat with the locality. At a distance of five miles from the crater the lowest layer consists of white sand mixed with pieces of pumice-stone. This layer seems to occupy four-fifths or five-sixths of all the erupted mass. The upper one-fifth consists of bluish-gray sand of more uniform nature and of finer grains than the lower layers. In this darker deposit there is less pumice than in the lower layer. The upper part of the darker layer contains finer sand than the lower part, and has the appearance of well-mixed coarse mud. There is every reason to believe that the mud resulted from the mixing of sand and rain in the air and was not thrown out as mud from the volcano. It is evenly distributed, and the layer is sufficiently solid to support a mounted rider, the horse's hoofs leaving but little impression. The solidity of this upper layer is due to the fineness of its particles and their being packed by water. On the top of this darker layer fell several inches of light-coloured ash.

Within a radius of ten to twelve miles of the crater there fell also numerous stones. On the upper edge of the crater lies a belt of bluish finely-grained rock, about 800 feet in width. The blocks are large, weighing many tons each. Farther away from the crater the blocks are replaced by angular stones, from the size of a fist to that of a hazel nut. Some are finely grained, of a bluish colour; others contain large crystals of hornblende in a light-coloured matrix. The former resemble basalt; while the latter appear to be some kind of coarse granite. Compared with the enormous quantity of the erupted mass the stones are very few. Of pumice-stones both larger and smaller pieces were erupted. The larger pieces of

pumice are now most readily found caught in the branches of the trees. The largest found measured one foot in diameter; but these are exceptional, judging from the pumice found floating in the ocean. For miles and miles the surface is covered with a blanket of pumice-stone, entirely hiding the water from view.

The temperature of the projected sand seems to have been cold, at least when it reached the ground. The lowest vegetation immediately under the first deposited mass remains perfectly uninjured, and is yet fresh and green. In places where the rain has washed away the sand this vegetation, consisting of grass and tender leaves, is so little harmed that it begins growing when exposed to the light. It has not even been bleached. The sand could not, therefore, have been very hot when it reached the ground; but the fact that the stones thrown out appeared as shooting stars in the air sufficiently shows that the mass was intensely heated.

Besides these heavier particles of sand, stones, and ash there were enormous clouds of vapour ejected by the volcano, principally of steam mixed with sulphurous fumes. There was no eruption of fiery gases or directly poisonous fumes.

The later daily eruptions were confined to steam and gases, and at my departure from the volcano on December 4th no lava had been thrown out.

Loss and Injury caused by the Eruption.

Temporary Injury to Vegetation.—Within a district about twenty miles wide and seventy-five miles long all the trees lost their leaves and all the tender vegetation was injured. This destruction was due to the grinding effect of the falling sand and not to its temperature. In this vast district, which extended half-way down the coast to the ocean, not a green leaf could be seen when the clouds scattered sufficiently to allow a good view. Many of the trees had been split and killed by lightning; while nearly all had branches broken, and some were uprooted. The leaves of the Arabian coffee trees had dried up. The berries were dried, and had assumed a dark gray colour, long before they had arrived at maturity. These berries were still not entirely lost, but were being harvested as an inferior coffee. Where the fall of sand was less than two feet deep fewer leaves had been killed and more berries remained green. The Liberian coffee trees seemed to be uninjured, their berries and leaves remaining perfectly green, even in places where the native vegetation had been destroyed.

Where the fall of sand only amounted to five or six inches no

injury seems to have been caused. The actual loss of the coffee is calculated to have been about eight-tenths of the whole crop in the district devastated, or about one-half of the crop of the Pacific coast of Guatemala.

Permanent Injury to Vegetation.—This injury cannot as yet be accurately judged. Within a radius of three miles from the crater every particle of vegetation appears to have been permanently killed. I am of the opinion that where the coffee trees are covered with over four feet of sand the plants will be permanently destroyed; while, where less than this amount has fallen, it will take the surviving plants from two to three years to recover their bearing capacity. Where, however, the fall has been as little as five or six inches it seems as if the trees may recover in two seasons.

As to the permanent injury done to the forest trees, nothing can be now said, except that wherever they are covered up to any great extent they will probably die. The area of destroyed forest is less than the area within which the coffee plants are destroyed. Already, a month after the eruption, the majority of the trees began to send out fresh leaves from uninjured branches; while the coffee shrubs, which had lost their branches, sent out fresh leaves from their main trunks.

Injury to Animal Life.—Nearly all the birds over an enormous area seem to have been killed. After the first eruption birds could be seen everywhere on the roads in a dazed condition, running hither and thither, and easily caught by the hand. It is probably that all such starved and injured birds died. A month after the eruption the blackbirds had returned, and seemed as happy as before. They were probably the only birds which had sense enough to save themselves by flight. It is probable that mammalian life was destroyed to even a greater extent than the birds. At every step in the forest we were offended by the odour of dead animals buried under the sand. The world of insects seemed to be renewed. Butterflies and beetles were found in many places; while flies and mosquitoes were numerous. The large ants, called *zompopos*, had already began to dig their new canals, and we found them carrying up the underlying brown soil and placing it on the white sand five feet higher up.

Great numbers of cattle had been killed. Those that had not succumbed during the first few days had died afterwards from eating leaves and grass covered with sand or from drinking water mixed with mud.

Of human beings the loss was great, and it is probable that as many as 1,500 were killed, principally by falling roofs, or by lying down on the ground and thus being covered up. The majority of the men got drunk in order to "keep up their courage," I was told.* To this fact must be ascribed the greatest loss of life. Except in the immediate vicinity of the new crater nearly every human being could have saved himself by starting towards the coast at the first breaking out of the volcano.

INJURY TO THE SOIL.—In the vicinity of the crater the soil is covered by sixty feet of sand. All such land is irreparably destroyed. In places where the deposit only amounts to a few feet or a few inches the continued vegetation will soon form new top-layers of leaf mould. The newly-deposited sand is not likely to be able to produce surface crops until such mould is formed. This injury to the soil is more serious than any temporary injury done to the crops. Even in places where the coffee trees survive it is to be doubted if new shrubs can be made to grow in the new layers.

Another injury to the soil is found in the numerous gullies formed by the washing away of the sand. To cultivate such a soil will be very difficult and costly. Every inch of ground is covered with sand over a large territory. In a small village which had not been entirely destroyed some one calculated that there had fallen twenty thousand tons of sand for every man, woman, and child. And still in this place there were only nine inches of sand covering the ground.

I was shown in several places ground which had been changed in colour by the deposited sand, and it was believed that such soil had been greatly injured in quality. Thus on the finca Felicidad the superintendent told me that his most fertile black soil had been turned red. We dug out such soil in various places; and though I had not examined it previously, I have every reason to credit the statement. But I had observed that the roads running through such black lands were always of a chocolate red, even in places where no sand had been deposited; and it seems probable that the change in the colour of the soil was due to some oxidation or other chemical action. The vegetation of this soil which had been changed to chocolate red was entirely uninjured by the overlying sand.

INJURY DONE TO BUILDINGS, ETC.—The injury done to buildings resulted principally from the caving-in of the roofs through the

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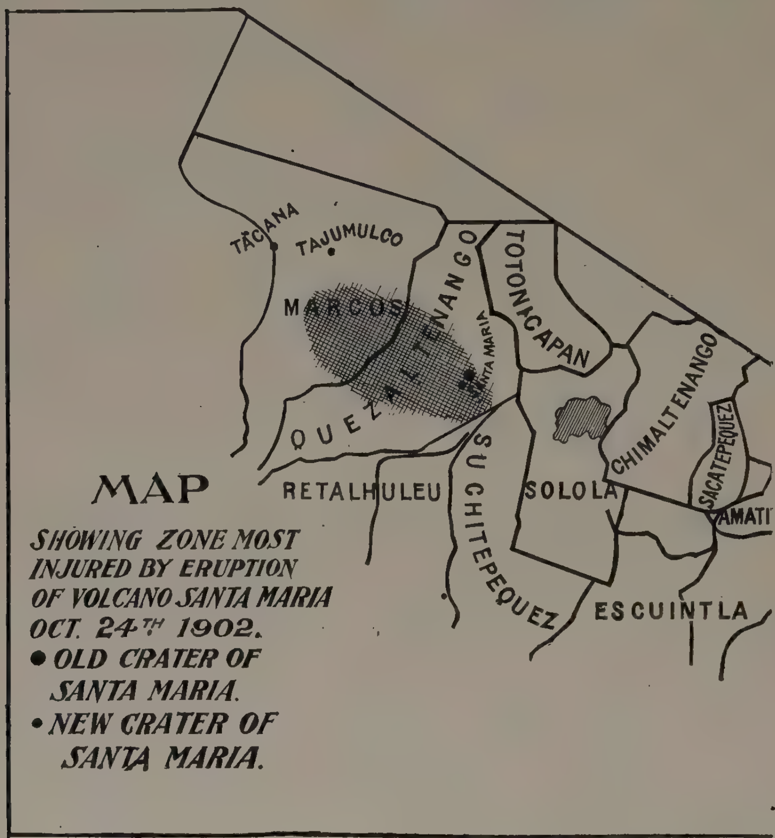
* A statement more easily made than verified.—(*Ed. Bulletin.*)

accumulation of sand. It has been great, but it has been much overestimated. In Retalhuleu, for instance, the first reports were that almost every house had been destroyed, while in fact not a single house had caved in or been seriously injured.

Injury to the Land in General.—Great injury has been done to the river-beds and river banks, as has already been stated. This injury is permanent; but it is lessened by the fact that the beds have



now been made larger, and future floods will be less destructive. One of the most serious results of the eruption is that for several leagues on each side of the port of Ocos the shore-line has subsided. About one hundred feet all along this coast has sunk down, and the waves now reach up to the very houses which before the eruption stood that distance away from the shore. This subsidence began after the earthquake of April 18th, but increased after the eruption. The costly iron pier for the landing of freight was

broken in two by the earthquake, and the injury done then has since increased. The lower part of the River Ocos changed its course, and the village is now threatened also from that side.

Comparative Injury of the Various Zones in the Devastated District.—The part of the coast especially injured by the eruption is generally known to outsiders as the Costa Cuca. The inhabitants, however, divide this coast into several distinct zones, separated by rivers or places not well suited to the cultivation of coffee. These zones have been variously affected by the eruption, as follows:

Xolhuitz.—About six leagues square. The largest part of the coffee and sugar-cane crop is destroyed.

Costa Cuca.—About 12 leagues by 6 leagues. Totally destroyed crops.

Chuva.—About 8 leagues by 4. Crops almost totally destroyed.

Costa Grande.—About 8 leagues by 3. Crops partly ruined.

Tumbador.—About 8 leagues by 3. Only slightly injured.

Costa Pamachan.—About 6 leagues by 8. Crops not injured.

Red Sunsets.

Before the eruption of Santa Maria no such red sunsets had been seen anywhere. But immediately after the eruption red or blood red evening skies were observed in the belt covered with ashes. These sunsets did not reach Guatemala City for one month after the eruption, the winds probably carrying the ashes the other way. When I passed along the Pacific coast in the middle of December the red sunsets did not appear higher up than Acapulco. Several weeks later they had reached the coast of California, but were of much less intensity than in Guatemala. They seemed to decrease in intensity as they proceeded northwards.

Prehistoric Eruptions of Sand and Ash.

It is of considerable interest to inquire into the effects caused by former eruptions of the Guatemala volcanoes, and if, perchance, any one of them resembled the eruption of Santa Maria. I made a special point to study this matter wherever opportunity offered.

As already noted, the eruptions of the Guatemala volcanoes since the earliest times have been of three kinds. The first eruptions were those of basaltic rocks. These lava-flows are yet, to a great extent, in evidence, their topsoil, as well as their alluvial deposits surrounding them, having been washed away long before the present alluvium of the coast was formed.

The second, andesite volcanoes, seem never to have produced any lava-flow of extraordinary dimensions. At least in modern times all lava-flows have been small and ceased not very far from the craters. The third class of eruptions consisted of sand and ash of nearly the same quality as those of the last eruption. From below Pacaya to the northern end of Tacaná the slope of the coast is mainly made up of deposits of white sand, covered by layers of various coloured humus soils, varying in depth from a few feet to a hundred feet. On the coast side there is little opportunity to study these deposits, but to the interior of the cordillera the numerous and deep barrancas offer excellent profiles for study. All the volcanoes, with the possible exception of Pacaya, have in prehistoric times thrown out immense quantities of ash and sand, principally made up of finely-ground pumice-stone. These deposits reach as far northwards as Salamá, Rabinal, Huehuetenango, etc., and seem to have been carried there from the Pacific coast volcanoes yet in existence. The greatest deposits, both as regards extent and thickness, are those found north of the Volcan de Agua. On the way from Chimaltenango to Mexico we pass several deep barrancas in which the strata of volcanic sand and ash alternate with strata of chocolate-coloured loams. I have counted eight or nine such alternating layers. Generally, the layer of chocolate loam is from one to six feet deep; while the white sand and ash layers are from ten to twenty-five feet deep. But in a barranca near Santiago, Sacatepequez one of these layers of erupted sand measured about one hundred and fifty feet, and immediately below it was seen a stratum of chocolate-coloured soil about six feet thick. It will thus be seen that at certain intervals eruptions of sand and ash have taken place since the first volcanic outbreaks, and that these eruptions have been succeeded by periods during which vegetation regained its hold and was able to form a humus of a chocolate colour from one foot to ten feet in thickness. The most recent of these, the largest deposits of sand, seems to have come from Agua. The uppermost erupted layer from this volcano, as observed on the road from Antigua to Guatemala City, averages in depth about four feet. Above this layer is deposited a stratum of humus about three feet thick. If we could calculate the time it takes in this region to form a certain layer of soil it would, of course, be possible to determine the years gone by since the last eruption of Agua. This may have occurred three or four thousand years ago, the formation of humus in this region being very slow, on account of the long dry season and the poor vegetation generally so far inland.

THE CLIMATE OF SOUTH AMERICA.*

BY

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The chief controls of the climate of South America are (1) the triangular shape of the continent, which is broadest near the equator and narrows southward; (2) the lofty mountain ranges along the western border, and (3) the cold ocean current off the Pacific coast. The broadening of the land-mass near the equator and the absence of high mountains along the Atlantic coast expose the greater portion of the vast northern and northeastern sections of the continent to the influence of the northeast and southeast trades, and ensure a remarkable uniformity of climate, with very small temperature ranges, over this whole region. The narrowing of the land-mass towards the south prevents the strong seasonal variations in temperature which characterize the broader continental areas in corresponding latitudes of the northern hemisphere, as, for example, in the case of North America. North America, like South America, is open on the east to the influence of the Atlantic; but while this fact is of the greatest importance in the southern continent, where the trades are thus given free access into the interior, the absence of high mountains along our own Atlantic coast has much less effect, because our prevailing winds are offshore. The mountains along the west coast of South America provoke rainfall on their windward slopes, and form a clearly-defined barrier between the climates of the narrow Pacific coastal

* The writer is indebted to the editors of "The Times" Supplement to the *Encyclopædia Britannica* for permission to make use here of his article on The Climate of South America, which was written for that Encyclopædia.

Reference may be made to the following articles by the writer, in which various additional facts in connection with the climate of South America are emphasized: "Meteorology in South America," *Science*, N. S., Vol. V, 1897, 523–525; "Water Surface Temperatures of Lake Titicaca," *ibid.*, Vol. VII, 1898, 28–29; "Climatic Contrasts along the Oroya Railway," *ibid.*, 133–136; "A Note on the South American Coastal Cloud," *ibid.*, 1898, 211–212; "A Winter Barograph Curve from the South Pacific Ocean," *Monthly Weather Review*, Vol. XXV, 1897, 484–485; "The Climatic Control of Occupation in Chile," *Journal of School Geography*, Vol. II, 1897, 289–292; "Climatic Notes made during a Voyage around South America," *ibid.*, 1898, 241–248, 297–311; "A Day in the Falkland Islands," *Journal of School Geography*, Vol. II, 1898, 49–56.

zone and those of the eastern slopes and plains. The cold Peruvian current is instrumental in giving the coast of northern Chile and Peru temperatures considerably below those which are common to their latitudes, and in contributing largely to the aridity of these countries.

South America lies between the mean annual isotherms of 40° and 80° Fahr. The northern and northeastern portions of the continent, down nearly to the latitude of Rio de Janeiro, are within the district enclosed by the mean annual isotherm of 80°. The cold Peruvian current deflects the isotherms strongly equatorward along the Pacific coast, especially between latitudes 30° south and the equator; while these same isotherms loop strongly poleward over the land. These deflections are much less marked towards the southern extremity of the continent. The equatorward deflection of the isotherms on the west coast results in giving places on that coast much lower temperatures than those of stations in corresponding, or even in much higher, latitudes on the east coast. Thus Lima, in latitude 12° south, has a mean annual temperature of 66.2°; while Rio de Janeiro, which is nearly on the tropic on the east coast, has a mean annual of 72.1°. Pernambuco, in latitude 8° south, also on the east coast, has a mean annual temperature of 78.4°. The mean annual temperatures on the Atlantic coast between latitudes 30° and 40° south are about 5° higher than those in corresponding latitudes on the Pacific coast.

The seasonal migration of the sun north and south of the equator involves some changes in the distribution of temperature over South America. The average position of the axis of the equatorial belt of high temperature ("mean annual heat equator") is on the immediate sea coast in northeastern Brazil. From here the line runs northwest, parallel with the coast of Guiana and Venezuela. In January the heat equator moves to about latitude 15° south, in Brazil; while in July it migrates northward beyond the limits of the continent. In the former month the isotherm of 50° crosses the southernmost extremity of South America; while the belt of highest temperatures, enclosed by the isotherm of 80°, covers eastern and southern Brazil, and extends well into Argentina. In the southern winter (July) the temperature gradient over South America is somewhat stronger than in summer (January); but the change in the value of this gradient is not nearly so considerable as it is over the northern continents. Thus it appears that the southern summer is not marked by excessively high mean temperatures, and the southern winter is moderate, even in the higher latitudes. In

July the isotherm of 30° is found somewhat south of Cape Horn; while the belt of highest temperatures (over 80°) is found along the northern and northeastern coasts.

The mean annual ranges of temperature are very small over all of South America. Over the northern portion of the continent, including Peru, northern Bolivia, and the greater portion of Brazil, the range is less than 10°. Over a considerable part of this same area the range is even less than 5°. South of the tropic and east of the Andes the ranges increase to between 30° and 40° in northern Argentina. In contrast with these larger ranges in the continental interior on the eastern side of the Andes, the mean annual ranges in Chile, on the other hand, are less than 20°. The whole of the narrow western coastal strip thus has a very moderate climate. Even in the higher latitudes the winters are very mild, and the summers distinctly cool. One of the most notable facts in connection with the temperatures of South America is the marked negative anomaly (−10°) near the equator off the west coast, which is due to the cold ocean water from the Antarctic flowing along the coast as the Peruvian or Humboldt Current. The effect of this cold water upon the temperature of the continent is seen in the presence of a negative anomaly of more than 2° along the coasts of Chile and Peru.

Another interesting effect is the exclusion of coral polyps from the Galapagos Islands; while they live on similar islands in much higher latitudes farther west in the Pacific.

Over a portion of the coasts of Guiana and of eastern Venezuela the mean minimum temperatures average over 68°. The lowest mean minima are found in the interior, east of the Andes and south of latitude 20° south. Temperatures below 32° occur normally every winter over the highlands of the southern interior of Brazil, and thence southward over the interior of Argentina. The highest mean maxima (104°) occur in the northern portion of Argentina. All of the west coast has decidedly lower maxima. Throughout the mountainous region of South America, altitude controls temperature to a marked degree. Places situated far above sea-level —as, for example, Quito—enjoy "perpetual spring" temperature. On the high peaks, even on the equator, there is eternal snow. An interesting lesson in the effect of elevation above sea-level in modifying climate may be learned by any one who takes a trip up the famous Oroya Railway, from sea-level at Callao to a height of 12,178 feet at Oroya, passing on the way, at Galera Tunnel, a height of 15,665 feet—the highest point reached by any railroad in

the world. The first part of the journey is through fields of sugar-cane and cotton; at 5,000 feet a zone of fruit trees is passed through; at 10,500 feet there is a district famous for its potatoes, where little else is grown; above this the altitude is so great as to preclude the growth of anything but grass. At the highest point reached the snow lies on the mountain summits throughout the year, and the traveller may enjoy a snowstorm in the middle of summer (December–February). Farther along the railroad, in the valley of Oroya, farm produce is again seen growing. This whole succession of climates may be passed through in the short space of ten hours—an opportunity offered to the traveller nowhere else in the world.

For the mean of the year, the barometric equator (axis of the equatorial belt of low pressure) crosses South America closely along the line of the geographic equator, running north of it on the west coast. The central portion of the continent is under the control of the tropical high-pressure belt; while over the southern extremity the pressure decreases rapidly towards the South Polar region. The seasonal migration of sun and heat equator involves a sympathetic migration of barometric equator and tropical high-pressure ("horse latitude") belt. In January the barometric equator moves south to about latitude 15° south in Brazil; while the axis of the tropical high-pressure belt, which is interrupted over the continent, lies about along latitude 30° south in the Atlantic and latitude 35° south in the Pacific. In July the barometric equator lies along the northern coast, and the axis of the tropical high-pressure belt is also farther north than in January. Seasonal changes and mean monthly ranges of pressure are slight.

The prevailing winds are controlled by the pressure distribution just noted. The broad northern portion of the continent east of the Andes and north of the tropical high-pressure belt is in the trade-wind zone. Here the trades prevail, as a rule, throughout the year, except when the sun is overhead. They are then temporarily replaced by the equatorial belt of calms and rains, which migrates north and south over the northern portion of the continent, following the sun. The west coast within the trade-wind latitudes south of the equator has its own system of winds, which is under the control of the tropical high-pressure area of the Pacific. These winds blow from a southerly direction along the coast nearly to the equator. Coming from a high latitude, and blowing over a cold current, these are cool and drying winds. The winds of extra-tropical South America are also chiefly controlled by the tropical

high-pressure areas of the South Atlantic and South Pacific oceans. The former of these areas gives easterly and southeasterly winds over the lower latitudes of the eastern portion of the continent, and prevailing northwesterly winds in the higher latitudes. On the west coast strong southerly winds blow with trade-like regularity along the coast north of the Pacific anticyclone; while northwesterly winds prevail to the south of it. The seasonal migration of these areas of high pressure involves a corresponding shift in the wind systems under their control. In summer, when the high-pressure belt is farthest south, south and southwest winds prevail along the west coast between 30° and 40° south; while south of latitude 40° north and northwest winds predominate. In winter the winds between 30° and 40° south are variable, with some calms; while the west and northwest winds blow nearer the equator than in summer. Thus the latitudes occupied by the southerly winds are extended in summer, and those occupied by the northerly and northwesterly winds are extended in winter. The harbour of Valparaiso, although well enclosed towards the south, is open to the north. When a *norte*, the indraught from lower latitudes towards a cyclonic centre, blows, as it often does in winter, and with considerable violence, the vessels at anchor in the bay are obliged to steam or to be towed out into the open ocean in order to avoid being blown ashore. In corresponding latitudes on the east coast there is also a northward extension of the limits of the northwest winds in winter. In Argentina northeast, east, and southeast winds increase in summer, and north, northwest, and west winds in winter. South of the tropic, and directly in the lee of the Andes, winds are of light velocity, and calms are frequent; while farther east, at a greater distance from the mountains, the velocity increases, and strong winds are common. In the mountains the winds are much influenced by local topography.

Darwin first distinctly emphasized the essential features of South American rainfall. In the latitudes of prevailing westerly winds (trades) the eastern side of the continent and the eastern slopes of the Andes are well watered; while the western slopes are comparatively dry. In the latitudes of prevailing westerly winds the western slopes of the mountains have the most precipitation; while the eastern side is dry. The rainfall is considerable (60–80 inches and over) on the elevated windward coasts of the continent (Guiana, southeastern Brazil) within the trade-wind belts, as it is on the eastern slopes of the Andes and over an extended area along the River Amazon. Within the southeast trade belt there is notably

less rainfall in the lee of the highlands of southeastern Brazil, and the rainfall also decreases rapidly in the interior over the more southern latitudes of this same belt, the country becoming almost a desert towards the eastern base of the Andes. The migration of the belt of equatorial calms and rains over the northern portion of South America involves a seasonal rainfall over the greater portion of the trade-wind latitudes. There is a dry season while the trade blows, and a rainy season while the equatorial rainy belt is overhead. This seasonal rainfall is well shown in the rainfall over the *llanos* of Venezuela and the *campos* of Brazil. The llanos have their rains during the northern summer, when they are under the equatorial rainy belt. During the rest of the year they are dry, when the sun is south and the trades blow across them. The *campos* of Brazil likewise have their rain in their summer (October–April), when the sun is south of the equator; while dry weather prevails during their winter, when the trades blow. The coasts of Guiana and Pernambuco and Bahia have winter rains. These rains are heavy, and are due to the onshore winds and the presence of high land near the coast. Pernambuco, situated just south of the extreme eastern point of South America, is exposed during most of the year to the strong southeast swell, produced by the southeast trade, and landing is therefore often very difficult.

The west coast within the trade-wind latitudes, from about 4° to about 30° south, is very dry. It is shut off from the trades by the great Cordilleran ranges on the east, and has prevailing cool southerly winds. These southerly winds, the spiral outflow on the eastern side of the South Pacific barometric maximum, cooled by the cool ocean water over which they blow, are decidedly warmed when they flow over the warmer land, and thus become drying winds, their capacity for water vapour being increased as their temperature is raised, although the presence of a range of coast-hills near the sea, along the greater part of the west coast, obliges these southerly winds to climb, and the adiabatic cooling produced by their ascent is not carried far enough, under ordinary circumstances, to produce rain. The coast cloud is a very marked phenomenon more or less all along the coast north of Valparaiso. It extends inland ten or fifteen miles at the points where the writer was able to make personal observations on it, and its base is between 2,000 and 3,000 feet above sea-level. As long as the southerly winds and the cool ocean current follow the coast, so long is the coastal strip dry and barren. As soon as the winds and current turn offshore, the previously-barren shores become covered with

vegetation. Analogous examples are to be found on the west coast of North America and the west coast of Africa. Although it very seldom rains along the desert coastal strip, rain and snow fall on the mountains of Peru and Bolivia during the summer. North of latitude 3° or 4° south there is abundant rainfall from the equatorial rainy belt, reaching 160 inches a year on the coast of Colombia north of the equator. Guayaquil has its rainy season from December to May. Near the west coast the migration of the equatorial rain-belt produces two rainy seasons when the sun is overhead, and two dry seasons when the sun is north and south. Quito and Bogotá have this double maximum of rainfall. Within the latitudes of the prevailing westerly winds the rainfall reaches over 80 inches annually along the southern coast of Chile. East of the Andes, over much of the pampas of Argentina and Patagonia, the average is under 10 inches. Towards the southern extremity of the continent the rainfall east of the mountains increases again, reaching 40 inches a year in the extreme southeast. In southern Patagonia the barrier on the west, owing to the diminishing heights of the mountains towards the south, is less effective than farther north. Furthermore, there is also a considerable precipitation from winter cyclones, whose influence extends over the low-lying Patagonian coast from the neighbouring Atlantic.

There is a seasonal distribution of rainfall in Chile, which depends upon the migration of the tropical high-pressure belt. Northern Chile, north of about latitude 30°, is always dry. Here is the desert of Atacama. Southern Chile has rain throughout the year, because it is always under the régime of the prevailing westerly winds. In the central portion there are rains only in winter, when the westerlies blow on that coast. The great climatic interest of the west coast of South America lies in the contrasts between the heavy rainfall on the southern coast of Chile, the intermediate barren desert belt of northern Chile and Peru, and the heavy rainfall on the coast north of Cape Blanco and Pt. Pariña, the westernmost point of the continent. These differences in rainfall have a close analogy in the rainfall on the west coast of North America.

So far as observation goes, no tropical cyclones originate in the South Atlantic, and all of equatorial South America is free from them. Cyclonic storms are, however, very common in the latitudes occupied by the prevailing westerly winds. The passage of such cyclonic storms across Argentina causes marked changes in wind, temperature, and weather. The warm, damp northerly wind (*norte*) in front of these depressions is followed by the cool, dry *pampero*

from the southwest, on the rear. The *pampero* corresponds in general to our own northwest wind, which is the rear indraft into a cyclonic centre. It is usually cool, dry, and bracing. The exclamation attributed to the first Spanish arrivals in this region, "*Que buenos aires son estos!*" must have referred to the conditions which prevail with a southerly wind, and not to those which the *norte* brings. The name *Buenos Aires* perpetuates, as is often the case with geographical names, a climatic feature of the region in which the city lies. Thunderstorms are most frequent over the northwest coast, as far as latitude 4° south, and occur in considerable numbers over all of South America within the tropics, except on the west coast, south of latitude 4°. The violent summer thunderstorms of the Argentine and of Uruguay often do serious damage to shipping in the Rio de la Plata estuary. The strength and the steadiness of the cyclonic-bearing westerly winds around the southern extremity of South America usually make the voyage around Cape Horn from the east very stormy and tedious; whereas vessels passing the Horn from the west usually have fair winds. The Strait of Magellan is used by all steamers which have to go around the southern end of South America; while sailing vessels are obliged to round the Horn, owing to the narrowness of the Strait and the difficulties of navigation through it.

Following Supan, South America may be divided into six climatic provinces. The first ("Tropical Cordilleran") includes the extreme northwestern section (the coasts of Colombia and Ecuador), with "perpetual spring" climates at high altitudes; high temperature near sea-level, and tropical rains. The second ("South American Tropical") takes in the vast northern and northeastern territory east of the Andes, and reaches somewhat south of the tropic. This is under the control of trades and of equatorial rains, and has mean annual temperatures over 80°. The third ("Peruvian") extends along the Pacific coast to 30° south, including northern Chile. This province is abnormally cool and rainless. The "North Chilian" province adjoining it on the south has a sub-tropical climate, with winter rains. Further south, the "South Chilian" province takes in the extreme southern extremity of the continent, is very rainy, and has equable temperatures throughout the year, with cool summers. The sixth ("Pampa") province, which includes the section east of the Andes and south of the "Tropical" province, has a fairly large range of temperature, especially in the north; while rain is not plentiful.

GUAYAQUIL AND QUITO RAILWAY.

BY

F. W. BENNETT.

Among South American countries Ecuador has been especially backward in railway construction. The country, from north to south, is traversed by two cordilleras of the Andes, on which are found some of the loftiest summits of the American continent. Between these ranges, at an elevation of from 8,000 to 12,000 feet, is a plateau, in the plains and valleys of which the bulk of the population live. Their only communication, across the mountains to the coast, has been by pack trains, over trails for many months of the year scarcely passable. Here, apart from the current of modern progress, they have lived in practically the same condition since Pizarro conquered the ancient kingdom of Quito.

Recently, there has been finished a railway to the heart of this beautiful region, connecting it with the principal seaport, Guayaquil. As early as 1873 the first link of this railway was built by the Government. Beginning at Yaguachi, thirty miles of road were built, in an easterly direction, through the towns of Milagro and Naranjito. Connection between Guayaquil and Yaguachi was made by small river steamers. The assassination of the President, Garcia Moreno, worthy of remembrance for his great abilities, stopped further progress for twelve years.

In 1885 the Government entered into a contract to extend the road to Guayaquil and to Riobamba, in the interior. The Yaguachi River was bridged, and the road built to a point called Duran, on the Guayas River. Guayaquil is three miles below, on the opposite side of the river, and a ferry is run between the two places. This part of the line was built across a swamp, and for a number of years, till sufficient ballast had been hauled, much trouble was caused by the settling of the roadbed. It was also flooded every rainy season; but the opening of numerous wide culverts has remedied this defect.

The largest steamers engaged in the west coast trade visit Guayaquil; and there is sufficient depth of water for them to ascend to Duran and discharge cargoes at wharves, which could be constructed without large expense, as deep water extends close inshore.

To the eastward, over the coast plain, the road was extended to

Chimbo, at the foot of the mountains. From Yaguachi to Chimbo, 56 miles from Duran, the surface is a plain, rising almost imperceptibly to an elevation of 1,000 feet at Chimbo. This plain is heavily timbered, save where, in the vicinity of the line, plantations of sugar, coffee, rubber and cacao have been cleared.

At Chimbo the real difficulties of the enterprise, the ascent of the mountain, commenced. A continuous grade of 3% and curves as small as 40° were used. Numerous switchbacks were proposed to make the necessary development. Difficulties, both physical and financial, soon led to the abandonment of the work, and it was thirteen years more before anything further was accomplished.

In 1898 the Government of General Alfaro let a contract to a company of English and American capitalists to extend the road to Quito. It is due to this company that by far the most difficult and costly part of the line has already been built.

Realizing the disadvantages of the line previously projected, a survey was made up the Chimbo River, crossing the cordillera at the foot of Chimborazo; but it was found that this route offered no advantages over the other. There remained only, with the limitations of grade imposed by the contract, the region of the former attempt.

The Chan-Chan River breaks through the western cordillera in a deep gorge near Chimbo. High up on its precipitous slopes the line was located and construction started. This part of the Andes is of the cretaceous formation. The slopes, facing the Pacific, are bathed in perpetual mist and rain. The action of the waters, the chemical action accelerated by the tropical climate, has disintegrated the original soft rock; land-slides have been of frequent occurrence, till the slopes to great depths consist almost entirely of a compacted earthy material, resting just at the angle of repose, but held somewhat by a mass of tropical vegetation. When the right of way was cleared, and deep cuts were made, after the season of the heavier rains commenced, the whole mountain above, in many instances, began to move. The line had to be abandoned.

Undaunted by failure, the company turned its attention to a valley line in the bottom of the gorge of the Chan-Chan. But this was only possible by using an increased gradient. A new contract was made with the Government, by which grades up to 5½% were permitted. By using the narrow bottom lands, crossing and recrossing the stream to avoid cliffs and heavy cuttings, a practicable line was secured.

Beginning at a point called Bucay, on the old line, 54 miles from

Duran, the River Chimbo is crossed by a two-span steel bridge 177 feet in length. The line then passes over the low dividing ridge, between the Chimbo and Chan-Chan rivers, and enters the valley of the latter stream, which it follows to the eightieth mile. The river is crossed no less than twenty-six times. There are in all forty-three steel bridges on this part of the line. I-beams are used for spans up to 30 feet; from 30 feet to 100 feet plate girders, and from 100 feet to 153 feet, the longest span, either riveted or pin-connected trusses. The abutments are either of concrete or stone masonry, and are of the best construction. Three projecting points were cut off with tunnels, one of which, 256 feet in length, was lined with timber.

At the eightieth mile the Chan-Chan is formed by the junction of the Alausi and Achupallas rivers. The Alausi, in the lower part of its course, has a fall of 12% or over in many places; while above its fall is from 3% to 5½%, thus reversing the fall usual in most rivers. To ascend to the upper course of the river development became necessary. For ten miles the line is supported on the mountain side. Development was accomplished by a switchback and a loop. Cuts here are not so difficult to maintain, as the country is much drier, and the material of a different character from that below.

The switchback lies on the steep slopes of a bold nose of rock jutting out where the two rivers meet. Numerous retaining-walls were necessary. In one place a trestle 200 feet long is built on the slope. At the eighty-eighth mile, near the village of Alausi, the line crosses a ravine on a steel viaduct 340 feet long. Two other ravines above are crossed by single-span bridges. At the ninety-second mile the line crosses the Alausi, below a fall, on a steel viaduct 373 feet long and 122 feet high, and then re-enters the river bottom, which is followed for 8 miles more. The line then ascends a small side stream to the broad flat pass of Tiocajas, the divide between the waters of the Pacific and the Amazon, at an elevation of 10,648 feet. Then, descending over an easy country, the village of Guamote, 112 miles from Duran, is reached. The road is in operation to this point at present.

The gauge of the road is 3 feet 6 inches, and the weight of rail 55 lb. per yard. Ties are of California redwood. All timber, except for the most temporary purposes, had to be brought from California or Oregon. There is no timber in the interior, except the planted eucalyptus. Firewood, for domestic purposes, is brought for miles from the scrubby growth on the high mountain side. Both

wood from the coast and English or Australian coal are used in the locomotives. Near Guamote a promising bed of coal has been discovered, which, it is hoped, will solve the fuel question. The Shea geared engine is used mostly on the mountain division.

The minimum curve is 29°, and the maximum grade 5½% compensated. This maximum grade is confined to a portion of the mountain division 38 miles long. The remainder of the constructed line, and the line yet to be built, will have a grade not to exceed 3% on tangents. The heavy grade is to be operated as a pusher. With the fine water-power easily developed close at hand, sooner or later this part of the line, at least, will be operated by electric power.

Construction, especially in the Chan-Chan valley, was attended by many difficulties. No one had passed up the gorge previous to the location of the railway. The first thing to be done was the building of a mule trail. All heavy construction material could only be brought ahead as the track was laid, though tools, explosives, food, and a great deal of cement were packed over the rough trails. On the lower section of the line timber was dragged by oxen down the mountain side for the construction of temporary bridges.

The native Indian labourers, who live by choice in the highest altitudes, sicken at once when brought to work in the lowlands. The Chan-Chan valley, especially, had a bad name with them for its unhealthfulness. Until an elevation of 6,000 feet was reached none of them could be induced to work. The labour for the construction of the lower part of the line had to be imported from Jamaica.

From Guamote to Quito, 160 miles, the road will lie over a much easier country. The route passes over a rich agricultural region, through numerous towns, and the cities of Riobamba, Ambato, and Latacunga. On either hand lie the snow-clad summits of Chimborazo, Tunguragua, Iliniza, and Cotopaxi. This part of the line would form a link of the proposed Intercontinental Railway. At present the journey is made by stage coaches over the highway built by Garcia Moreno. This road is 30 feet wide, and in places is paved for miles; grades do not exceed 12%, and the streams are spanned by beautiful stone arch bridges.

The advent of the railway seems to have quickened interest in the almost unknown territory of the Oriente, lying at the foot of the eastern cordillera. The Government is now building three roads into this country. All accounts describe it as having a fine climate and as rich in all natural resources.

NOTES ON THE U. S. GEOLOGICAL SURVEY.

The United States Geological Survey has recently changed, somewhat, its plan of publication. For several years the Director's Report, with accompanying papers and a review of mineral resources, has filled several large volumes annually. Hereafter the Director's Report will be confined to one volume, and a series of unbound Professional Papers of quarto size will be issued. The Mineral Resources will appear separately in ordinary octavo, as also the series of Bulletins designed to place promptly before the public matters of economic and scientific interest. There is continued, also, the series of Water-Supply and Irrigation Papers. All of the above are open to free distribution by the Survey and by Members of Congress. The folios, atlases, and monographs will, as usual, be sold at the cost of publication. Circulars and maps giving lists of publications, and showing the progress of the topographic survey, may be had on application to the Director of the Survey.

Of the Water-Supply and Irrigation Papers, Nos. 65 to 79 have recently been received. This series does not contain all of the material on these subjects that is issued by the Survey. Extended reports on hydrography and on various aspects of irrigation have made part of the annual reports for several years.

No. 76 of the series named above is by Mr. H. A. Pressey, and gives a review of observations on the flow of rivers in the vicinity of New York City (108 pp., 1903). From 1890 to 1900 the use of water-power in the United States increased 30 per cent., or nearly one-half million horse-power. This fact alone shows the value of quantitative study of our streams. The case of Austin, Texas, is cited by the author. A power plant was there built at a cost of $1,600,000, and it was then found that the flow of water fell 500 per cent. below the estimate. In one instance in New York State five engineers gave in their results, making the minimum flow vary as one to two.

Possible water supply for New York City is noted in the light of ascertained conclusions—namely, that Lake George is inadequate, that Lake Champlain is too low for economical use, and that the Great Lakes would be tapped at too great expense. Several stations for gauging were established in 1901, and furnished the data for this paper. The stations and streams were as follows

(all in New York except one): Dover Plains, on Tenmile River; Gaylordsville, Conn., on the Housatonic; South Cairo, on Catskill Creek; Kingston, on Esopus Creek; New Paltz, on Wallkill River; Rosendale, on Rondout Creek, and Glenham, on Fishkill Creek.

Observations on the height of the water were made twice each day and current-meter measurements at frequent intervals. These observations supply data for computing the annual flow, and with accompanying maps for determining sites of needed reservoirs. Methods of finding velocity are described, including the use of current-meters, surface and sub-surface floats, and weirs or dams. The last, already in existence for other purposes, often supply a convenient means of computing the discharge. Both the methods and the results may be considered as typical of the work performed by the Survey in all parts of the United States and serving the needs of those who use power or seek for water supply.

The report also gives studies of turbidity and colour, the latter being mainly due to vegetable matter in solution. The waters of New England and New York are little turbid as compared with those of the South Atlantic States or those of the Ohio and Mississippi Rivers. The turbidity determines the amount of coagulant needed in filters and the size of reservoirs needed to supply clear waters in periods when the rivers are carrying a large body of land waste. Detailed tables show turbidity, colour, alkalinity, hardness, and discharge per second for the several streams.

Paper No. 79 in the same series is by M. O. Leighton, and bears the title Normal and Polluted Waters in Northeastern United States. Rivers vary in the purposes for which they are of most value. Some streams are worth more for carrying away the refuse of manufacture than they could be for harvesting ice or for fishing grounds. The Merrimac, which is first studied, has small value for transportation, is famous for power, and has important ice fields about its upper waters. This river, as a whole, has been studied more carefully, in the author's opinion, than any other river in the world. Pollution of the lower river has been serious, and has taught costly lessons, particularly in Lowell and Lawrence. There, as commonly, the loss entailed was far beyond the cost of prevention. An interesting contrast appears between two tributaries—namely, the Sudbury and the Assabet, forming the Concord. Both basins are thickly populated; but the waters of the former are nearly normal, because the large towns are on the edge of the basin and do not befoul its waters with their sewage. The Assabet

waters, on the contrary, are polluted beyond the point of safe domestic use.

The Blackstone is *the most polluted river in New England*, occupying a densely-populated valley, and receiving, besides the ordinary sewage, a vast volume of manufacturing waste. The waters sometimes show an acid reaction. The conditions are worse because a great city, Worcester, begins the pollution almost at the source. Still, the value of the river for power more than compensates the loss in other directions.

The Connecticut, up to Hartford, is valuable for transportation. The aggregate power is enormous, and is far short of being utilized, although the power at Holyoke is the largest in this country, except Niagara. The value of the river down to the Massachusetts line is unimpaired for water supply and for ice, but in Massachusetts pollution becomes serious. This does not hold of the western tributaries in that State, the Deerfield and Westfield Rivers, which drain a mountainous and thinly-settled country. The policy of the State, however, is thorough, and warrants the expectation of improvement in the waters of the trunk stream.

The Housatonic is next described; and in this connection interesting extracts are given from decisions of the courts of Connecticut dealing with questions of water pollution, particularly between private riparian owners and cities and towns situated up the streams. The Delaware and the Ohio Rivers are embraced in this report, the latter in much detail. All the basins are illustrated by outline maps of the smaller component basins.

It is shown that, under some conditions of the Allegheny River, sewage poured in at Oil City would reach Pittsburg in fifteen hours, putting out of reckoning all question of "self-purification" between the two cities. Tests of the river water at Cincinnati in 1898 showed that the typhoid bacillus was probably always present. The observer, Mr. Fuller, states:

> From the evidence at hand it is probable that, by taking two cubic centimeters for each test, this germ would be found practically without exception. Upon taking one cubic centimeter for each test the identity of this bacillus was established in 60 per cent. of the samples, as shown by the results of tests.

These results follow in tabular form. The paper as a whole includes all the more important and available records of water examinations in this country, except those in connection with the Chicago Drainage Canal and the Illinois River.

Paper No. 72 in this series deals with Sewage Pollution in the Metropolitan Area near New York City, and is of intense practical

interest. The author is Mr. M. O. Leighton. It is a curious fact that the Raritan, except near its mouth, is quite free from pollution, and most of its tributaries offer safe water for use. The Passaic, on the other hand, is much the most valuable drainage system in New Jersey, and its waters reach in some cases the extreme of defilement. The river is described in detail as to profile, tributaries, amount of discharge, conditions of population, and resulting pollution. Under the last head the facts given are astonishing, and demand attention and action. Municipalities like Jersey City and Newark, which secured other water-supply at great expense, experienced immediate relief from the diseases incident to the use of contaminated water.

Fish have, for the most part, disappeared from the river. The stench arising from the stream, and from the foul matter lodged on its banks, has made parts of the river belt unhealthful and almost uninhabitable. The cities of Paterson, Passaic, Orange, and Newark, and many towns, discharge their sewage into the river. The Passaic Valley Sewerage Commissioners' report is quoted at some length, the extract closing as follows:

> In short, the pollution of the lower Passaic river appeared to the commissioners to be completely established as a public nuisance, an injury to health, and an increasing menace to property interests from the beginning at the Great Falls to below Newark.

The problem was taken up in 1899 by the State Sewerage Commission. Parts of their report show that the sewage is driven in and out along the lower river by the tides, effective flushing taking place only after large rainfall. People living a half mile away from the stream have been forced to close their windows to keep out the stench. Similar conditions were felt from Paterson to Newark Bay, and factory hands in Newark were repeatedly obliged to stop work.

Succeeding pages discuss the loss of values in water supply, ice, fish, and realty. Fixing a low-water rate, the value of the supply equals a principal of over eighteen millions of dollars, which, under existing conditions, is lost. It is partly offset, however, by uses for power. The greatest loss is in realty values. The author cites a 14-acre tract for which $40,000 was refused less than twenty years ago. This piece of land cannot be sold at any price.

The remainder of the paper is devoted to the Hudson and its branches. The reader must turn to the report itself for all but the barest summary. Below Poughkeepsie the water is affected by the salt; hence pollution occasions no loss. From Poughkeepsie to Troy the river is polluted, but its commercial value is more than

compensation. Conditions are not here growing worse, for population is scarcely increasing. There is rapid growth, however, above Troy, both along the main stream and on the Mohawk. These parts are of value for power, water supply, and ice. The Hoosick offers a case of inter-State complications, owing, especially, to the pollution of its headwaters at North Adams. In fact, the waters of this stream are worse where they cross the New York and Vermont line than when they enter the Hudson. The Mohawk, from Rome to its mouth, offers a belt of great increase of population and of serious pollution. Schenectady has abandoned its intakes from the river; but Cohoes, which is below the entire population of this thronged valley, *is still contented to drink from the cesspool of its neighbours.* This is a more aggravated case than that of Troy, which is slowly learning the lesson, but furnished ground for the remark by a sanitary expert before a Senate Committee in the District of Columbia that *up in Troy anything short of soup would be satisfactory.*

The question of pollution is of vast importance in the case of the Hudson, as a source of ice and a possible source of water for Greater New York. Indeed, Mr. James H. Fuertes, in an investigation following the Ramapo job, favoured the adoption of the river supply to be taken out above Poughkeepsie. Other recent titles in the water-supply series are: The Motions of Underground Waters, No. 67; Water Powers of the State of Maine, No. 69; Irrigation Systems of Texas, No. 71; Water Resources of the State of Colorado, No. 74; and Preliminary Report on Artesian Basins in Southwestern Idaho and Southeastern Oregon, No. 78.

Bulletin 213 of the Survey embraces Contributions to Economic Geology, by various authors. Several recently-exploited petroleum fields are here described, including, first, those of California, which are mainly south of the latitude of San Francisco. They lie in the central valley of the State, within the Coast Range, and along the Pacific front. Details of the several districts are given. Of these the Kern River field is the most productive. It is shown in general for the oils of the State that they are developed in strata of late geological age which have been subjected to folding and in some cases to faulting. The total thickness of these beds is at least 20,000 feet, carrying ten or twelve oil horizons. Conditions warrant the expectation that other fields will be discovered, but the supply is plainly exhaustible.

Another of the newer fields is in the neighbourhood of Boulder, in Colorado. This is reported by Professor N. M. Fenneman of

the University of Colorado. Oil springs, due to seepage, have been known for more than thirty years. The first oil was struck in January, 1902. The oil lies in slightly gritty layers of Pierre shale, which often would not be called a "sand" but for the presence of the oil. There is little correlation of the sands at definite levels; hence it would not seem to be possible to predict horizons at which the product is likely to occur. No stratum has been proved to extend for a half mile. "Shooting" has been beneficial in some cases but harmful in others. Eighty-two wells have been sunk to considerable depths in the central and chief part of the field, and thirteen pumps are working regularly. At the time of writing there was daily shipment of two hundred barrels of crude oil. It will thus be seen that the output of the region is as yet relatively small.

Far more extensive are the oil resources of the Texas–Louisiana Gulf Coastal Plain, here reported by Mr. C. W. Hayes. The account is brief, being an advance summary of a Survey Bulletin now in press. The region included is a belt 50 to 75 miles in width, reaching from near the Mississippi River in Louisiana two-thirds across the State of Texas. As in the Boulder field, there is no observed continuity of oil-bearing strata. Small local domes exist in the beds, due to some form of vertical uplift. The oil is associated with these, and they reveal themselves in low hills or broad surface swells. The "pools" are small as compared with central Texas or the Appalachians. Oil was discovered in January, 1901, and within a year and a half there were 280 wells producing from the Spindletop pool at Beaumont. This pool is limited to about 200 acres; and it is suggested that a few well-placed wells would have tapped the supply quite as effectively, and at great saving of expense. Like the oil and gas reservoirs of Ohio and Indiana, the oil rock is a porous crystalline dolomite. The porosity is greater here than in the more northern States, and includes distinct cavities an inch or more across. The author estimates that one-third of the space is occupied by cavities, which means large storage and early exhaustion as well.

"Gushing" is a characteristic feature of the Gulf region, and is due to the expansive force of pent-up gases. The pressure has greatly declined; hence spontaneous flow is followed by pumping, which, in turn, will become unprofitable. In quality the oil resembles that of California rather than that from the Appalachians, and will be used mainly for fuel, having some advantages over coal, especially for locomotives.

Bulletin No. 209 discusses the geology of Ascutney Mountain, Vermont. This is hardly a locality of general geographic interest, and most of the Bulletin is occupied with petrographic and structural facts which have no place here; but the author, Dr. R. A. Daly, draws the interesting conclusion that no such powerful glacial erosions took place in New England as has been proved for the fiord region of Norway or the valleys of Switzerland. Mount Ascutney has no definite stoss-and-lee form, its radiating ravines are deep and of pre-glacial origin, and the "pre-glacial Ascutney had practically the form of the present mountain." That glacial erosion should be large under some conditions and small in others is rational, and helps to explain the opposing verdicts of different observers. What we need is a precise knowledge of these conditions.

The latest volume of Mineral Resources of the United States covers the year 1901. Instead of appearing according to the custom of later years, as part of the Director's annual report, it now stands by itself and goes back to the ordinary octavo form. It is compiled by David T. Day, Chief of Division of Mining and Mineral Resources, and contains 996 pages, giving in text and tabular form brief reviews of all mineral products of the United States.

Of the new series of Professional Papers about a dozen have been received. Nos. 1 and 2 form additions to the already considerable body of Survey literature dealing with Alaska. No. 3 is a detailed report on the Geology and Petrography of the Crater Lake National Park, the senior author being Mr. J. S. Diller, who has already given us briefer but excellent accounts of this now famous region. Papers 4 to 9 deal with forest conditions in various parts of Washington, Oregon, and California. Some of these are lavishly illustrated, and contain a large amount of detailed information. Paper No. 10 belongs also to Alaska; and No. 14 is a somewhat bulky volume, giving a summary of chemical analyses of igneous rocks.

The Twenty-second Annual Report of the Geological Survey is the last to be issued in the old form, containing not only the usual administrative report of the Director, but several bound volumes, mainly of economic material, such as is now appearing under the general title of Professional Papers. Volume 1 contains the Director's Report; and this is followed by Mr. Geo. H. Eldridge in a review of the Asphalt and Bituminous Rock Deposits of the United States. To the average reader the great variety and the wide distribution of the hydrocarbons as a whole will be surprising. They may be gaseous; or fluid, like petroleum; or viscous, like mineral

tar; and thus the conditions pass to elastic, or solid. In their occurrence they may be mixed with limestone, with silica, or sand, or with earthy matter. Many analyses are given, and the inter-gradations and the difficulty of classifications are emphasized. The distribution is described and also delineated upon a map. In one form or another this class of products appears in West Virginia and Kentucky, east of the Mississippi River, and in Arkansas, Indian Territory, Missouri, Texas, Utah, and California, with minor occurences in other States. The localities are then described in detail, with many maps, sections, and views.

Volume 2 contains 888 pages, and is entirely devoted to various ore deposits, containing little that is of general geographical interest. Volume 3 is mainly taken up with a comprehensive review of the coal fields of the United States. Being the latest extended publication on this subject, it has much value as a work of reference, not only from the economic point of view, but also for teachers. Mr. C. W. Hayes gives a brief general introduction, and Professor J. B. Woodworth presents the first in the series of papers—an account of the coal beds of Triassic age, in the Eastern United States, in Virginia and North Carolina. This coal has long been known, and was mined as early as 1775; but it has been so overshadowed by the great Appalachian deposits of Carboniferous age that this Report and even the existence of such coals would be a surprise to most non-geological readers. In pursuance of the general object, to make this Report a complete and trustworthy summary, the other papers, like the first, are prepared by special students of the several fields. The reader is referred to the volume itself for titles, authors, and the great body of facts which can receive no notice here. The same volume includes reports on the Gaines oil field of Northern Pennsylvania, on the Portland Cement Industry in Michigan, and on the chalk of Southwestern Arkansas.

Volume 4 gives 500 pages to the results of stream measurement for 1900. This work is done under the direction of Mr. F. H. Newell, Hydrographer-in-Charge. In the same general field is the report that follows; it is by Mr. Arthur P. Davis, and discusses the Hydrography of the American Isthmus. The author begins with a summary account of the physiography of the isthmus. Temperature and humidity of various stations are given, with rainfall and wind movement. A brief notice is then given of the several canal routes—the Atrato, the San Blas, the Caledonia, the Panama, and the Nicaragua. A comparison of routes makes some interesting parallels, with data from Manchester, Suez, Kiel, and Sault Ste.

Marie. According to our author, no trade between Europe and the Orient will use an American canal, owing to the shorter distance by the Suez route; and even vessels from New York, headed to points south of Hong Kong, will go by Suez or the Cape of Good Hope.

The comparison between Panama and Nicaragua is not without interest, in the uncertainty which still exists. Nicaragua, being in the belt of trade winds, is more favourable for sailing craft; but the proportion of this class of vessels is small, and is likely to be smaller in the near future. Nicaragua would be chosen by sailing ships from the North, about 5 per cent. of the total traffic. Steam vessels from Gulf ports would have little choice between the two routes in reaching the west coast of North America. All others, or 70 per cent. of the whole, would prefer Panama. Steam vessels going to the west coast of South America would save nearly 400 miles by this route. Panama, on the other hand, is unhealthful; while Nicaragua is favourable in this regard, and is itself a region of vast undeveloped resources. This land is the most favourable anywhere to be found in the tropical belt of the world for Caucasian immigration. The opportunity to surround the canal with civilized life of a high type does not exist at Panama. The hydrography of both routes is then studied in detail.

This volume closes with a supplemental report on the High Plains and their Utilization, by Willard D. Johnson. The main body of this report was offered in the 21st Annual, and was reviewed by the present writer in an earlier number of this BULLETIN.

The twenty-third Annual Report of the Survey is the first to be published under the new plan. It is a single volume, giving the administrative report upon work done in the year ending June 30, 1902. The Director gives a short historical account of the growth of the new legislation concerning the arid lands, beginning with Major Powell's well-known report, which was prepared in 1877 and 1878, and coming down to the time when the President's distinctly-affirmed policy and the action of Congress have both expressed and strengthened the popular interest in this question.

As usual, the work of the numerous field parties is briefly described; and it is stated that Mr. C. W. Hayes has assumed the position of Geologist-in-Charge of Geology, and Mr. A. H. Brooks, after wide experience in Alaskan work, has been placed in charge of investigations in that increasingly-important region. There is a résumé of mineral resources, and the progress of the topographic department is given in detail, with progress maps for all parts of

the Territory. The report closes with a memorial of Clarence King (including portrait), Director of the Fortieth Parallel Survey, and first Director of the United States Geological Survey under the present organization. A. P. B.

MR. PEARY'S EXPEDITION TO THE ARCTIC.

Mr. Peary has obtained a three years' leave of absence from the Navy Department, to begin from April 1, 1904. The purpose is to enable him "to undertake an expedition for the attainment of the north pole and to secure general scientific and geographical information concerning the high polar regions." Mr. Peary sent to the Secretary of the Navy, with his application, the following letter explaining his plans:

WASHINGTON, D. C., Sept. 2, 1903.

SIR: Referring to my application for leave of absence accompanying this, I beg to state for your information that I propose to secure a suitable ship, put her into one of our best shipyards, have her reënforced and strengthened to the maximum degree and fitted with American engines, possessing the maximum of strength and power with the minimum weight and space, so that she may go north as an exponent of American skill and mechanical ability.

With such ship I should sail north about the 1st of next July, and on reaching the Whale Sound region should take on board my Esquimaux, establish my permanent sub-base at Cape Sabine, and then force my way northward to my proposed winter quarters on the northern shore of Grant Land, establishing caches as far as practicable *en route*. By the earliest returning light of the following February I should start due north over the polar pack with a small, light pioneer party, followed by a large, heavy main party. I should expect to accomplish the distance to the pole and return in about one hundred days or a little more, an average travel of about ten miles a day. Returning, I should break the ship out late in the same season and return home.

If ice conditions the first year were such as to prevent reaching the northern shore of Grant Land, I should winter as far north as practicable and force the ship to the desired location the following year. In this event the expedition would be gone two years.

This plan is the result of some twelve years of almost continuous experience in those latitudes, and is based upon an extended personal acquaintance with the region from Sabine to 84 degrees north latitude and a thorough familiarity with climatic and other conditions and with Esquimaux.

The distinctive features of my plan are: The use of individual sledges with comparatively light loads, drawn by dogs, giving a travelling unit of high speed and radius of reach, as opposed to the man sledge, with its heavy load, slow speed and limited radius; the adoption of Esquimaux methods and costume and the fullest utilization of the Esquimaux themselves.

The advantage of my plan and route are a fixed land base 100 miles nearer the Pole than on any other route, a more rigid ice pack extending Poleward than is to be found on the opposite side of the Pole, a wider land base upon which to retreat and a well-beaten line of communication and retreat from winter quarters to comparatively low latitudes, which is practicable at any season of the year.

The work outlined above comprises two distinct stages, viz.: The navigation of the ship to the northern shore of Grant Land, the traverse of the Polar pack with sledges from the northern shore of Grant Land to the Pole and return. In connection with the former, four ships (the Polaris, the Alert, the Discovery, and the Proteus) have accomplished this feat. In regard to the second, I have already made four trips in those same regions, in which the average air line distance from start to finish was the same as the distance from Grant Land to the Pole. The air line distance from start to finish of my 1900 sledge journey was such that had my starting point been the northern shore of Grant Land it would have carried me beyond the pole and return.

I beg to state for your consideration the following :

The North Pole is the last great geographical prize the earth has to offer. Its attainment will be accepted as the sign of man's final physical conquest of the globe, and it will always stand as one of the great milestones in the world's history.

The attainment of the North Pole is, in my opinion, our manifest privilege and duty. Its attainment by another country would be in the light of a reproach and criticism.

The sense of all the foremost geographers, practical and theoretical, now converges upon the Smith Sound or "American route," along which I have been working for years past. Other routes have been eliminated. If we delay in preëmpting this route, some one else will step in and win the prize.

I believe that my experience, gained in years of practical work; my special methods of travel and equipment, the evolution of years of practical work ; my personal acquaintance with every feature of my chosen route and region, and my command of the full resources and utmost effects of the entire little tribe of Whale Sound hyperboreans, who have lived and worked with me for years, give substantial reasons for anticipating a successful outcome to an expedition based on the above lines.

Very respectfully,

R. E. PEARY,
Civil Engineer, U. S. N.

To this letter Mr. Charles H. Darling, Acting Secretary of the Navy, wrote the following reply under date of Sept. 5:

DEAR SIR : In granting you leave of absence for the purpose of prosecuting your Arctic work, I am moved to remark that I believe you are better equipped than any other person in the country to undertake this work. You have the requisite courage, fortitude and physique. You have had a longer term of service within the Arctic circle than any other explorer. You have had large experience in sledge journeying, both upon the land and upon the polar pack. You are familiar with ice conditions through the Smith Sound route and north of Grant Land and the continent. You have demonstrated your ability to maintain yourself in that latitude for a longer period in health and safety than any other explorer. You have reduced the inconveniences and hardships of the Arctic service to a minimum.

You are conversant with the language and customs of the Whale Sound Esqui-

maux and are personally acquainted with every individual in the tribe. They have become accustomed to your leadership, and if you succeed in transporting the selected hunters and the best families to the north shore of Grant Land, as you propose, you will thereby establish a base which will enable you to live in safety and comparative comfort for an indefinite period.

Grant Land as such base has great advantages over Spitzbergen, Franz Josef Land, or any other known point, in that it has an extensive shore line, which a party retreating from the Pole cannot fail to find, whatever may be the extent of the polar drift.

In establishing a colony of Esquimaux at this point, you thereby establish a self-sustaining base at the nearest practicable point to the Pole. Such self-sustaining base has not heretofore been established in any such high latitude. Your ability to force your ships to a high northing with this Esquimaux colony is all important to your success. Such northing has been made by the *Polaris*, the *Alert*, the *Discovery* and the *Proteus*. There would seem to be no reason why you cannot do the same. Knowledge of ice conditions that has been gained since that time will certainly enable you to provide a ship better adapted to the purpose than either one of these.

The attainment of the Pole should be your main object. Nothing short will suffice. The discovery of the Poles is all that remains to complete the map of the world. That map should be completed in our generation and by our countrymen. If it is claimed that the enterprise is fraught with danger and privation, the answer is that geographical discovery in all ages has been purchased at the price of heroic courage and noble sacrifice. Our national pride is involved in the undertaking, and this department expects that you will accomplish your purpose and bring further distinction to a service of illustrious traditions.

In conclusion, I am pleased to inform you that the President of the United States sympathizes with your cause and approves the enterprise. With best wishes for your health and confidence in your success, I am, respectfully,

Charles H. Darling,
Acting Secretary.

GEOGRAPHICAL RECORD.

NORTH AMERICA.

THE DEVELOPMENT OF THE UNITED STATES.—*Ergänzungsheft* No. 142 to *Petermanns Mitteilungen* is entitled "Die Entwicklung der Vereinigten Staaten von Nordamerika." The writer, Mr. Richard Blum, has prepared numerous tables derived from our Census Reports, some of them extending back as far as the first census, to show the increase in our population in every State and Territory, the elements of which it is composed, the history of immigration, and the growth of our cities. The tables devoted to the chief agricultural crops are full of interest and of suggestive comparison, showing for each State and Territory the number of acres in each crop in the last four census years, the harvest in bushels or tons, the average productivity per acre, the average value per bushel or ton, and the total value. The statistics of live stock and the number and value of farms, farm buildings, and agricultural machinery are treated in the same exhaustive manner. The history of the development of our mining industry, general manufactures, commerce, and merchant marine as shown by statistical tables is admirably presented. The volume concludes with a sheet containing ten maps of the country, showing graphically the territorial growth of the United States, the steady western movement of the centre of population, and the product per acre and the price per bushel or ton of each of the cereal crops, potatoes and hay, in each of the States and Territories for the year 1900. No foreign publication has ever given so complete and intelligible a statement of our economic development and present condition. Each series of tables is prefaced by remarks of an explanatory nature and by deductions from the tables, to which attention is especially called. The work is important, not only as a convenient and authoritative reference book relating to the United States, but also as a contribution to anthropogeography.

THE SCHOOL OF GEOGRAPHY IN THE SUMMER SESSION OF CORNELL UNIVERSITY.—An announcement of this interesting experiment was given in the April number of this BULLETIN. Considering the alarm produced by the typhoid epidemic of last winter, the attendance was large, and the health of the school was as perfect as in any previous year. Teachers from seventeen States were registered

in the School of Geography, representing grade, normal, and high schools and superintendents. Professor R. S. Tarr, the Director of the school, gave courses in Physiography and the Physical Geography of Europe. Professor Albert P. Brigham gave courses upon Dynamic Geology and the Geography of the United States. Commercial Geography was treated by Principal Philip Emerson, of Lynn. Courses dealing more directly with method were given by Dr. C. A. McMurry, upon Type Studies and Home Geography, and by Supervisor R. H. Whitbeck, of Trenton, upon Class Room Problems and Laboratory Methods in the Grades. Laboratory work in Geology was directed by Mr. Geo. C. Matson, and in Physical Geography by Assistant Principal Frank Carney, of Ithaca. The local region was very thoroughly covered by field excursions in Physiography, Geology, Commercial and Home Geography, and longer excursions were made to Watkins Glen, Wilkesbarre, Union Springs, and Lake Ontario. A feature of the school was the round-table conference, held on one evening of each week, for the informal discussions of school problems in geography.

It is expected that this very comprehensive group of courses, with some additions that experience has suggested, will be again offered in 1904, with the same faculty. A. P. B.

Age of the Lansing Skeleton.—Professor N. H. Winchell re-enters the discussion of the age of the Lansing skeleton with a paper published in the *Bulletin* of the Geological Society of America (Vol. 14, pp. 133–152). It will be remembered that these human remains were discovered at Lansing, Kansas, in the loess deposits of the Missouri Valley by a farmer named Concannon, who was digging a root cellar. The skeleton was found beneath twenty feet of loess. Professor Winchell contends that the loess found in the Mississippi Valley is of aqueous origin; that the main body of it is contemporary with an ice epoch now known as the Iowan stage of glaciation, and that the skeleton proves the existence of man in the Iowan epoch, or in the fourth of the five glacial stages recognized in North America. It is assumed by glacialists that the fifth or Wisconsin glacial stage occurred at least 8,000 years ago. Professor Winchell says that the bones of the Lansing skeleton were buried by the volumes of mud and muddy water with which the Missouri Valley was filled, and that these sediments were augmented by materials from the Kansas drift.

Building Stone and Coal in Washington.—Vol. II of the Annual *Report* of the Geological Survey of Washington, 1902, is

devoted to two papers, one on the building and ornamental stones of the State and the other on its coal deposits. The granites are all light gray in colour, and are very good building material. The sandstones compare favourably with many of the best quarried elsewhere. Few of the marble deposits have been developed, and most of the promising marble properties, ordinary grades or decorative varieties, are in Stevens County, in the northeast corner of the State. The coal fields are chiefly in the west, extending in a broken line from the Canadian boundary to the Columbia River. Lying on the border, between the foothills of the Cascades and the Puget Sound basin, the fields are within easy reach of tide-water, and have excellent facilities for transportation. The output of the twenty-three coal-mining companies in 1902 was 2,690,789 short tons of coal and 40,569 tons of coke.

BOSTON DESCRIBED AND PICTURED.—The *Journal of Geography* signalized the meeting of the National Educational Association at Boston, in July last, by devoting its June number chiefly to that city. It depicted in an admirable series of articles the approaches to Boston, its geographical features and development, the influences which make it a great industrial centre, and other characteristics of the city. It is rarely that a great metropolis is so fully and adequately described from a purely geographical point of view. As a geographic study of the second greatest seaport of the United States these papers are to be heartily commended.

EXPLORATION IN HUDSON BAY.—The Canadian Government steamer *Neptune* sailed on Aug. 22 from Halifax for Hudson Bay and Arctic waters. A year and a half will be spent in botanical, geological, and natural history investigations. It is said that the party will take formal possession for Great Britain of the Arctic islands north of this continent and the shores of Baffin's Bay.

STORMS OF THE GREAT LAKES.—A recent publication of the United States Weather Bureau (Bulletin K, 4to, pp. 9, Charts 952), by Professor E. B. Garriott, deals with the storms of the Great Lakes, and is designed to furnish the observers of the Weather Bureau, and ship captains on the Lakes, such information as will help them to recognize, on the daily weather maps, the general weather conditions attending the approach of storms. There are in all 952 small weather maps, illustrating the more important Lake storms which have occurred during the twenty-five year period 1876–1900. Each storm is illustrated by four charts, covering 32

to 48 hours of its history. Usually, also, at least two of the charts present the general meteorological conditions over the United States and Canada eight to twenty-four hours before the storm centre reached the Lake region. November, with forty-five severe storms, heads the list for greatest monthly storm frequency. In June and August severe storms occur only about once in three years, and in July about once in four years. Thus it is clear that, as the navigation season draws to its close, the storms increase both in number and in severity. The straight gales of summer are an almost negligible quantity as far as forecasting is concerned. The most destructive Lake storms come from the southwest, and usually appear first in the region of the southeastern slope of the Rocky Mountains, the Rio Grande Valley, the coasts of northeastern Mexico, and the western part of the Gulf of Mexico. The season of these southwest storms is from October to May. The storms from the lower Missouri Valley, or "Middle West," are next in order of severity. They appear first on the middle-eastern slope of the Rocky Mountains, or swing southeast from the northwestern States, or the north Pacific coast, and then recurve to the east or northeast. The storms from the middle west are common at all seasons, but the most severe ones occur chiefly in the colder months. "Northwest Storms" include the greater number of the Lake storms. This class takes in all disturbances that move from the northeastern Rocky Mountain slope, and the British Northwest Territory almost directly toward the upper Lakes. During the colder months many of them advance from the north Pacific Ocean. Storms of this type are seldom destructive over the Lake region. The Lakes also suffer occasionally from storms of tropical origin, which have come from the Gulf of Mexico or the South Atlantic coast of the United States. A useful little "wind-barometer table," on page 9 of the Bulletin, shows the kinds of wind and weather indicated in the Lake region, with different heights and changes of the barometer.

R. DEC. W.

NATICK DICTIONARY.—The Bureau of American Ethnology has issued as *Bulletin 25* a dictionary of Natick language (XXVIII and 347 pp.). The dictionary is in Natick-English and English-Natick. The language was that of the Natick Indians of Massachusetts, a tribe of Algonquian stock. It was into this language that John Eliot made his famous translation of the Bible (1661–63), and as only fourteen complete copies of his work are now known to exist, they are valued at very high prices. This dictionary is the result of the scientific study of Eliot's Indian Bible by Dr. James Ham-

mond Trumbull, who gave the closing years of his life to the preparation of the vocabularies which are here printed from his manuscript. Dr. Edward Everett Hale, who contributes an introduction to the dictionary, says that the descendants of the Algonquian tribes of Massachusetts have not retained a knowledge of their dialects, but the Passamaquoddy and Micmac Indians of Maine still use their dialect of Algonquian stock.

West Indian Hurricanes.—The August, September, and October issues of the *Pilot Chart of the North Atlantic Ocean*, issued by the United States Hydrographic Office, have frequently contained brief accounts of the class of cyclones known as West India Hurricanes, because these storms occur chiefly during our late summer and early autumn months. The *Pilot Chart* for September, 1903, contains an excellent, albeit necessarily somewhat brief, discussion of West India Hurricanes, prepared by James Page, of the Hydrographic Office (reprinted from Hydrographic Office Publication No. 86, Gulf of Mexico and Caribbean Sea, Vol. I, 5th Ed., 1901). This discussion, while intended primarily for seamen, is not technical, and will prove useful for other persons as well. The path usually followed by these hurricanes carries them from their place of origin, in the northern margin of the doldrums, in a direction between west and north to the northern limit of the trades, and then in a direction between north and east. This path takes most of these storms along, or near, the Atlantic coast of the United States. Occasionally, instead of following this regular track, a hurricane keeps to the westward, across the Gulf of Mexico, before recurving, as was the case with the Galveston storm of September, 1900. The months of maximum frequency of occurrence are September and October. Of 56 hurricanes recorded by the United States Hydrographic Office in the 11-year period, 1890–1900, 41 occurred in these months.

While within the tropics the area of low pressure and violent winds rarely exceeds 300 miles in diameter, in higher latitudes this may be considerably increased. In the old days the "8-Point Rule" was believed to apply to all parts of a tropical cyclone, but now every seaman knows that it is only within the comparatively small area covered by the central depression that the direction of the wind is nearly at right angles to the barometric gradient. Farther out, the wind blows more directly towards the centre, and, although observations on this point differ greatly in different parts of the same storm, and in different storms, six points (67° 30′) may be taken as about the value most commonly noted, although too

much reliance should not be placed on the accuracy of this method of determining the bearing of the centre. The distance of the centre can best be determined by noting the height of the barometer and its rate of fall; the force of the wind; the movements of the clouds, and the rapidity with which the wind shifts. The matter of manœuvering, to keep a vessel away from the dangerous centre; or to get her into the "navigable semicircle"; or to make the best use of the winds on the outskirts of the storm to help her on her course, has been very carefully worked out, and the result of many years of study of hundreds of observations has given the following brief rules for handling vessels in tropical cyclones: In the left semicircle (with respect to the storm track) the wind shifts to the left; lie-to, if at all, on the port tack. In the right semicircle, the wind shifts to the right; lie-to, if at all, on the starboard tack.

R. DeC. W.

Health on the Isthmus of Panama.—Gen. Henry L. Abbot, U. S. A., discusses the important question of health on the Isthmus of Panama in a recent article on the *Climatology of the Isthmus of Panama* (Monthly Weather Review, XXXI, No. 3, 1903, 117–124). During the construction of the Panama Railroad no health statistics were made public, but they were undoubtedly appalling. At that time the question of acclimatization was not understood nearly as well as at present, and natives of the temperate regions were made to perform hard manual labour under the tropical sun. Now it is known that dependence for such work must be placed on West Indian negroes, because, although white men can supervise in the Tropics, they should not attempt more. During the period of canal construction, and especially during the time of the New Panama Canal Company, careful health records were kept, and the following table, which is a summary of one prepared by Dr. Lacroisade, for many years medical director of the Company hospital at Panama, gives a good idea of the health conditions during the last twenty years:

Years.	Mean Effective Force Employed.	Mean Annual Percentage of Disease.			Mean Annual Percentage of Mortality.		
		Diseases of Europe.	Diseases due to Climate.	Mean Total per Year.	Diseases of Europe.	Diseases due to Climate.	Mean Total per Year.
Old Company, 1881–1888.	10,854	18.83	42.75	62.58	3.05	3.92	5.97
Receiver, 1889–1894.	971	....	....	49.68	....	....	2.88
New Company, 1895–1901.	2,703	....	....	37.17	2.10	0.51	2.61

Dr. Lacroisade attributes the marked reduction in the death-rate to the better accommodations of the laborers, to better drainage, and especially to the fact that the excavations have reached a level below the poisonous emanations of decaying organic matter. He finds that for the last four years, with a personnel of 2,275, the percentage of disease has been 29.65, with a mortality of 2.35 per cent., which he believes do not exceed those on large works in any country. The employees concerned in these latter figures had been on the Isthmus some time, and were well acclimated. Dr. Lacroisade believes that yellow fever is in nowise necessarily endemic on the Isthmus. The completion of sanitary works, the cleaning of streets, and the filling in of many swamps in Colon have evidently been very effective in freeing that city of yellow fever, for since 1891–92 Colon has been free from any infectious disease, and escaped the yellow fever epidemics of 1897, 1899, and 1900. Dr. Lacroisade thinks that by furnishing a good supply of drinking water, constructing sewers, watering and cleaning streets, and establishing effective quarantine, Panama would also have fewer yellow fever epidemics, and a residence there would be less dangerous for unacclimated white men than it is at present.

R. DEC. W.

HANDBOOKS OF THE LATIN-AMERICAN REPUBLICS.—The handbooks relating to the various Latin-American states, which are being compiled by the International Bureau of the American Republics, contain a large amount of recent and valuable information. Their usefulness, however, would be much enhanced if the material used were more carefully sifted and classified. In the latest issue, "Argentine Republic," for example, it is impossible to find in the 375 pages a comprehensive, orderly account of any of the great industries. Some of them are mentioned only in statistical tables. It seems certain that more critical selection of material and more concise and logical treatment of topics would result in better, smaller, and more useful books.

GEOGRAPHIC TABLES AND FORMULAS.—The United States Geological Survey has just issued as *Bulletin No. 214* a compilation of geographic tables and formulas relating to the work of the topographic branch of the Survey. The collection in one volume of this material, which is used by topographers both in the field and the office, will be useful to many.

DEATH OF CIVIL ENGINEER MORISON.—Mr. George Shattuck Morison, the eminent civil engineer, died in New York on July 1,

aged 60 years. One of his last public appearances was before the American Geographical Society in December, 1902, when he delivered an address on the Panama Canal before a large audience, including many distinguished members of Mr. Morison's profession. As a member of the Isthmian Canal Commission Mr. Morison had thoroughly studied the questions relating to the Panama Canal. His valuable paper on the subject was printed in the BULLETIN for February, 1903. Mr. Morison was born at New Bedford, Mass., was graduated from Harvard in 1863, and was especially known for the large number of bridges he had built, including fifteen across the Mississippi and Missouri rivers.

SOUTH AMERICA.

THE RIO NEGRO AND THE CASIQUIARE.—A correspondent asks for information as to the practicability of using the Rio Negro and the Casiquiare bifurcation which connects the Negro with the Orinoco as an outlet for the rubber product of the Amazon basin. Col. George Earl Church, one of the most authoritative writers in English on South America, may be quoted as to the navigability of the Rio Negro:

> The Negro is navigable for 450 miles above its mouth for 4 feet of water, in the dry season, but it has many sand banks and minor difficulties. In the wet season it overflows the country far and wide, sometimes to a breadth of 20 miles, for long distances; and for 400 miles up, as far as Santa Isabela, is a succession of lagoons, full of long islands and intricate channels, and the slope of the country is so gentle that the river has almost no current. But just before reaching the Uaupes* there is a long series of reefs over which the river violently flows in rapids, cataracts and whirlpools. (*Geog. Jour.*, Vol. 17, p. 367, 1901.)

The same writer says in a note on p. 365 of his article that a much shorter connection exists to the west of the Casiquiare between the Orinoco and the Amazon basins by the Isthmus of Pimichin. It is reached from the Orinoco River by ascending the Atabapo and its Terni branch. The latter is somewhat obstructed, but could easily be cleared out and made navigable. The isthmus (that is, the portage between the headwaters of the Terni and the Rio Pimichin) is ten miles across and is much used for the transit of large canoes which are hauled over it and thence, by the little river Pimichin, reach the Rio Negro.

We have found no evidence that the Casiquiare is used for commerce, though its channel is wide and deep. On the Amazon side the difficulties in the rapids of the Rio Negro presumably would

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* Also spelled Waupes.

interfere with long-distance transportation through the Casiquiare; on the Orinoco side the whole region has not advanced beyond the stage of pioneer exploration; the Casiquiare itself was not even fairly well known till the Chaffanjon expedition of 1886–1887 made it a subject of special study. Speaking of the Orinoco, Major Stanley Paterson says in his article, "In the Valley of the Orinoco" (*Geog. Jour.*, Vol. 13, 1899, pp. 39–50), that Ciudad Bolivar is practically the western outpost of civilization in that direction and the farthest limit of regular steam traffic on the Orinoco. The prospects that the Casiquiare will be used as a commercial highway between the Amazon and Orinoco basins in the near future do not seem to be important.

TRIGONOMETRICAL SURVEY OF BRAZIL.—The Brazilian Government has decided to begin a survey of the country on modern scientific lines. Preparations were being made in June for the triangulation of the State of Rio Grande do Sul by a commission under Colonel F. de Abreu Lima, who intended to measure bases at Porto Alegre and Uruguayana and to connect the two cities by triangulation. This arc will cover about 6.25° of longitude in 30° south latitude.

CLIMATIC CHARTS OF ARGENTINA.—Dr. Josef Chavanne has recently issued an important publication on the temperature and rainfall of Argentina (Vol. I of the Publications of the German Academic Association of Buenos Ayres). The rainfall records are reduced to the period 1861–1900, and the temperature records to the period 1856–1900. The charts show the annual and seasonal temperature and precipitation, and the temperature ranges and anomalies. The country is divided, climatically, into five general provinces, three of which are subdivided into two sub-provinces each.

R. DEC. W.

PARAGUAY REVIEW.—This publication, issued every three months by the Government of Paraguay, is devoted chiefly to the economic aspects of the country and the information required by immigrants. With the beginning of its third year in March last, all the contents of the magazine are printed in English and German instead of English and French. The change is made on account of the growing demand for information about the Republic in the German language.

EUROPE.

THE BERLIN GEOGRAPHICAL SOCIETY.—The completion of the seventy-fifth year of the existence of this Society was celebrated on May 4 last. As the anniversary nearly coincided with the seventieth birthday of the distinguished German geographer Baron von Richthofen, the two celebrations were combined. Prof. Hellmann gave an address reviewing the history of the Society, which he divided into three characteristic epochs. In its early days, from 1828 to 1859, it was concerned chiefly with the diffusion of knowledge of geographical work done elsewhere, and discussion of the results obtained. The year 1859 was marked by the opening of a period of great exploring activity on the part of the members of the Society—a feature that especially characterised its work during the second period. The third period, while continuing explorations on a large scale, as, for example, in the Antarctic, has been marked by more intensive geographic research, in the form of the detailed examination of smaller areas, and investigation of special problems. In this period, also, there has been continuous improvement in the value of the Society's publications, and eight volumes of the "Bibliotheca Geographica," which is regarded as a model of bibliographical enterprise, have been published. A new feature, which will still further contribute to the usefulness of the Society in the future, is the foundation of the "Ferdinand von Richthofen Stiftung," in honor of the great geographer. The sum of 26,000 marks, which the committee had collected, was handed over to Baron von Richthofen as a fund for the encouragement of geographical progress, the yearly proceeds to be devoted to the support of journeys, of geographical research, grants to geographical students, and other similar purposes.

ASIA.

RAINFALL OF INDIA.—India is one of the most interesting countries in the world from a climatic standpoint, especially as regards its rainfall. Cherra Punji, in the Khasi Hills, north of the head of the Bay of Bengal, has long been celebrated because of its having the heaviest rainfall in the world, 457.80 inches, according to the latest data available. Furthermore, the year in India is divided into three seasons—the cold, the hot, and the wet—with the general rains during the summer monsoon, the dry season during the winter monsoon, and finally the storms of the winter rains in northern India, which give winter weather types not very unlike many of

those in the United States. The late H. F. Blanford, in Appendix A of a memoir on the Rainfall of India (*Indian Meteorological Memoirs*, Vol. III), gave the monthly rainfalls for 457 Indian stations for various periods ending with December, 1886. In the latest publication of the Indian meteorological service (*Indian Meteorological Memoirs*, Vol. XIV. I. The Rainfall of India. 1902. Fol. Pp. x+709), Sir John Eliot has reprinted these data, and has brought them down to date by the inclusion of similar data for the fourteen years 1887 to 1900. The latitudes, longitudes, and altitudes of the stations have been corrected, and two columns have been added, headed "Total N. E. Monsoon, December to April," and "Total S. W. Monsoon, May to November." These two periods cover roughly the two rainfall periods of the year—*i. e.*, the cold weather or winter rainfall, and the southwest monsoon rainfall period. In the Introduction reference is made to the very natural objection which is likely to be urged against the use of the term "N.E. Monsoon," which really applies only to the rush of vapour-laden northeast winds along the eastern coast of India during October to December. But popular usage has so firmly established this nomenclature that its retention is justifiable. The term "S.W. Monsoon" has always been a legitimate one, as these winds prevail more or less generally over the whole country from June to September, and in southern and coast districts during October and November also. The present publication, embracing over 700 pages, gives the latest and most authentic data regarding Indian rainfall, and will, therefore, for some years to come, be the source of information on this subject. The series of *Indian Meteorological Memoirs*, which has already contained very many important contributions to meteorological science, shows no signs of diminishing in value as time goes on.

R. DeC. W.

The Philippine Weather Service.—Part II of the *Report of the Director of the Philippine Weather Bureau, 1902*, concerns "The Meteorological Service of the Philippine Islands," and was prepared by Father Marcial Solá, S. J., Secretary of the Philippine Weather Bureau. The Report is published under the seal of the Department of the Interior, at the Bureau of Public Printing, Manila (4to. Pp. 68. Figs. 12. Pls. VIII). Meteorologists have long known of the excellent work done by the Jesuit priests at the Manila Observatory, especially in connection with the study of typhoons; but the American public knows little of this institu-

tion, which has now become the central station of the Philippine Weather Service, and is carrying on that service by authority of the United States Government.

The Manila Observatory began its work in 1865, at the college known as the Ateneo, under the direction of the Jesuit Fathers, and with a few of the most indispensable instruments. Monthly and annual leaflets were issued from the start, giving the results of the observations. Father Federico Faura, S. J., was the first director, and under his enthusiastic leadership the instrumental equipment was soon increased, and in 1870 the publication of a monthly Bulletin was begun. On July 7, 1879, the first typhoon prediction was issued, and was fully verified by the storm which followed. In 1880, after Manila had been connected with Hong Kong by cable, typhoon warnings began to be sent to the latter station, at the request of the Governor of the colony. In 1884, as the result of representations made by prominent persons, official and otherwise, in Manila, a Royal Decree was issued, officially establishing a meteorological service in the island of Luzon, with secondary stations reporting to the central station at Manila, the director and sub-director (Jesuit Fathers) of the central observatory being paid for their services, and an additional appropriation being made for other expenses. The secondary stations were established and equipped as soon as possible, earthquake records being kept at all these places. The central station having outgrown its old quarters, a new building was erected and was occupied in July, 1886. This building is in the suburb of Manila known as Ermita, on slightly-elevated ground, near the sea, with an unobstructed horizon. The magnetical department, in its own building, was inaugurated in 1888, and the astronomical department, which also has its own building, was completely equipped in 1898.

During the war with Spain the work at the central observatory at Manila suffered no interruption. After the war, as the result of conferences between the members of the Philippine Commissions, the Secretary of Agriculture, the Chief of the Weather Bureau, and the Jesuit Fathers, the Philippine meteorological service was finally established in May, 1901, with Father Josè Algué, S. J., as director, the director being subject to the Colonial Government in the Philippines in the same way as the Chief of the United States Weather Bureau is to the Secretary of Agriculture. The officers of the Philippine Weather Bureau are a director (salary $2,500); three assistant directors (salary, $1,800); and one corresponding secretary and librarian (salary, $1,400). There is also a corps of

paid observers. After the war the secondary stations provided for in the new act establishing the Philippine Weather Bureau were organized as rapidly as possible. At the present time there are in operation: 1 central observatory; 9 first, 25 second and 17 third-class stations and 21 rainfall stations. A crop service, similar to that in the United States, was begun in August, 1901.

The report contains half-tone pictures of the Manila Observatory, and of various meteorological instruments. Plate VII, "The Special Pavilion for Tropical Regions," is of particular interest. There are also some views of different meteorological stations, shelters, etc., and a map showing the locations of the secondary stations. A list of the publications of the Manila Observatory, 1865–1902, occupies two pages. Among the recent publications the most important are, perhaps, "Baguios o Ciclónes Filipinos" (1897); Las Nubes en el Archipiélago Filipino (1899); "Climatología de Filipinas" (1900); and "The Climate of Baguio" (1902). Two valuable instruments have been invented by the Fathers at Manila—one the aneroid barometer of Father Faura, and the other the baro-cyclonometer of Father Algué. R. De C. W.

The Late Dr. Ziegler's Scientific Observations.—The "Physikalischer Verein zu Frankfurt am Main" could pay no higher tribute to the memory of the late Dr. Julius Ziegler than to devote, as it has done, a large part of its *Jahresbericht* for 1901–1902 to the publication of the results of his meteorological and hydrographic observations in the neighbourhood of that city, extending over a period of thirty-six years until within a few weeks of his death on Sept. 15, 1902.

AFRICA.

Standard Time in South Africa.—The Governments of Cape Colony, Natal, Transvaal, Orange River Colony, Rhodesia, and Portuguese East Africa, having decided to adopt a standard time for railroads, telegraphs, and other public purposes, have agreed that the time shall be that of the meridian 30° E. Long.—that is to say, two hours in advance of Greenwich time. The arrangement took effect from March 1 last.

Lake Chad.—*La Géographie* published in its number for June a map, "Iles du Tchad et Côte du Kanem," on a scale of 1:500.000, or 7.8 statute miles to an inch. The scale is sufficiently large to show all the numerous islands recently discovered along the whole

extent of the east side of the lake. The map is the combined result of surveys of eleven officers of the French military force in that region under the direction of Lieut.-Col. Destenave; and the map was prepared by Captain Bézu. Colours serve to differentiate the islands into low, wooded, and tilled islands and sandbanks. The geographic co-ordinates were determined for five places among the islands and for Djimtiloh, on the Shari River. A summary description of the islands, based upon the surveys above mentioned, was

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LAKE CHAD.

printed in the BULLETIN, 1903, No. 2, p. 187. The map contains an inset map of Lake Chad showing the important changes which the surveys have made in the outline of the great lake and also giving an excellent idea of the distribution of the islands discovered and surveyed. The map here given is based upon the inset map published by *La Géographie.*

The islands which fringe the east coast are due to the currents and prevailing winds, which have carried and distributed enormous quantities of sand. They extend with great regularity from north-

west to southeast. The mainland does not touch the open water throughout the whole eastern side of the lake. The width of the zone of islands varies from about 5 to nearly 20 miles. The channels between the islands rarely exceed 2 miles in width, and in many places are much narrower. Many of the islands are merely sandbanks, while others are occupied by forests or plantations. The actual shore of the lake is largely cut up into peninsulas, which reproduce the trend of the islands.

THE SURVEY OF VICTORIA NYANZA.—Commander Whitehouse, who, some time ago, completed an admirable survey of the shores of the Victoria Nyanza within the British sphere, north of 1° N. Lat., is now engaged under an agreement with the German authorities in a survey of the southern half of the lake, particularly in the interests of steam navigation. The steamer *Winifred*, recently placed on the lake, has circumnavigated it, and it is intended to establish a regular service between ports on all its shores. When this enterprise is carried out it is expected that the quickest route to Lake Tanganyika will be by the Uganda railroad and the Victoria lake. It is probable that Commander Whitehouse's survey of the lake will make important changes in the outline of its southern shores.

FAILURE OF THE MACMILLAN EXPEDITION.—The well-equipped expedition under Mr. W. N. Macmillan of St. Louis, which went to Abyssinia to descend the Blue Nile from Lake Tsana to the plains of the Sudan, was wrecked in the rapids of the river, on the Abyssinian highlands, soon after it started, on June 26, on the river journey. Two of the iron punts that carried the party were lost in the rapids. The occupants swam ashore, but, unfortunately, the lost punts contained the larger part of the stores, and further loss was suffered from a hurricane during the enforced detention of the expedition on the river banks. The party was compelled to return to Addis Abeba, and the journey has been abandoned for the present.

ANTARCTIC.

THE GERMAN ANTARCTIC EXPEDITION.—The German expedition on the steamer *Gauss* has returned home. The *Gauss* sailed from Kiel on Aug. 11, 1901, and arrived at Kerguelen Island, its Antarctic base, on Jan. 2, 1902. Dr. J. Enzensperger had preceded the *Gauss* on the supply steamer *Tanglin*, which carried all the material for the buildings to be erected on Kerguelen and the larger

part of the supplies which the *Gauss* was to take south. On Jan. 31, last year, Dr. von Drygalski and his comrades on the *Gauss* left Kerguelen Island for their journey into the unknown Antarctic. Dr. von Drygalski's official report was published on July 10 as a supplement to the *Reichsanzeiger*. Pack ice was reached on Feb. 13 in 61° 58′ S., 95° 8′ E. The *Gauss* sailed directly over the spot where Wilkes supposed that he saw the land which he designated "Termination Land." Wilkes was 60 miles from the place, and Dr. von Drygalski believes that the American sailor's mistake was due to the deceptive appearance of the icebergs. Seven days later, Feb. 21, 1902, the Germans discovered land. They were in front of a coast covered with heavy ice, evidently the edge of an ice-sheet extending over a land-mass. On one side was a bare volcanic peak rising to a height of 1,200 feet above the sea. The new coast was named Kaiser Wilhelm II. Coast and the little mountain was called Gaussberg. The next day the ship became frozen in the ice in a large bay on this coast, which was named Posadowski Bay. The party were imprisoned here for nearly a year till Feb. 8, 1903, their position being latitude 66° 30′ S., longitude 90° E. The extent of the land-mass was not discovered. Four sledge journeys, however, were made to the coast. The Gaussberg was ascended and found to be the only part of the land in sight not covered by ice. Photographs were taken, the geology of the mountain was studied, and an ice hut was built at its foot, and zoological, botanical, and geological specimens were collected. Better views of the surroundings were obtained in clear weather by balloon ascent to a height of 1,600 feet. The Gaussberg was the most conspicuous object. The edge of the coast could be traced far away to the east and west, and the undulating ice-covered surface stretched away to the south.

The party dredged the sea for marine life and regularly took magnetic, meteorological, and other scientific observations. When the results are worked out it will doubtless be seen that this expedition has added largely to the scientific knowledge of the Antarctic. During the winter months (from the end of April to the end of August) one snowstorm followed closely on another, especially in May and August, burying the ship, so that after each storm it had to be dug out of the snow. The rounds of the meteorological and other observers to obtain the instrumental records were exceedingly toilsome. The party saw two species of penguin, the small Adelia and the Emperor penguin, which were very useful for food, especially for the dogs. Seals were easily caught on the ice. The auxili-

ary party left on Kerguelen Island were most unfortunate. Dr. Enzensperger, the meteorologist in charge of the station, and several of his comrades, perished of beri beri. The station was abandoned in March last and the survivors arrived in Sydney on April 16.

THE NORDENSKIÖLD ANTARCTIC EXPEDITION.—The steamer *Antarctic*, having on board the expedition commanded by Dr. Otto Nordenskiöld, left Sweden in October, 1901, and went to Staten Island, Tierra del Fuego, where the Argentine Government had established a magnetic observatory for co-operation with the Antarctic expeditions. The party left Staten Island on Jan. 6, 1902, for Graham Land. Entering the channel, first shown by D'Urville, on the west side of Louis Philippe Land, they made an interesting discovery. Louis Philippe Land has been supposed to be an island, and is so represented on the maps; but it proved to be only the extremity of the land-mass known as Graham Land. On Feb. 12, 1902, Dr. Nordenskiöld reached Admiralty Inlet, on the coast of Graham Land, and began to prepare his winter quarters. He expected during the following fall and spring months to make sledge journeys over the land and extend knowledge of that region farther south. The *Antarctic*, leaving him and his five companions at their winter quarters, returned to South America with the news above outlined. In November last, about the beginning of the Antarctic summer, the vessel sailed south again, and it was the distinct plan that she should return with the entire expedition in February last. She did not return according to the programme, and, therefore, steps are being taken to send out a relief expedition.

RELIEF EXPEDITION TO VICTORIA LAND.—The British Admiralty is bearing the entire cost of sending a relief expedition to the Antarctic ship *Discovery* at Victoria Land. The supply ship *Morning*, which last season visited the *Discovery* in the neighbourhood of Mounts Erebus and Terror, will sail from Hobart this year instead of from Lyttelton, New Zealand, as before. All letters and parcels for the *Discovery* should reach the *Morning* at Hobart before December 1 next. The sealing vessel, the *Terra Nova*, purchased in Newfoundland, has been fitted for the voyage, loaded with stores, and will accompany the *Morning* as an additional precaution against possible mishap. If it is found impossible to extricate the *Discovery* from the ice in which she was frozen last year in time to return early in 1904, the entire party on that vessel will be brought home on one or other of the relief ships.

ECONOMIC GEOGRAPHY.

The Bremen Statistical Office.—Bremen maintains a statistical office, one of whose publications, the *Jahrbuch für Bremische Statistik*, is wholly devoted to the commercial interests of the port. That this phase of Bremen's activity is most thoroughly analyzed and reported may be inferred from the fact that the *Jahrbuch* for 1902 contains 327 large and closely-printed pages. Among these statistics are the number of vessels entering or leaving the port and its outports, with net tonnage, and value of cargo and the countries to which they are destined or from which they come, the quantity and value of each article imported or exported, whence derived and its destination, and the countries which have a share in the commerce of Bremen, with the quantity and value of every article imported from or exported to them. The index makes it easy to ascertain the total import or export trade in every article, and the share in the trade of each country. Thus the four and one-half pages given to the import trade from the United States show that 223 different commodities were brought into Bremen. The value of Bremen's imports from the United States in 1902 was 394,845,738 marks; exports to the United States, 92,581,446 marks. The *Jahrbuch* is a model for works of its kind.

Foreign Trade of China in 1902.—The official *Report on the Trade of China for 1902* (Imperial Maritime Customs, Shanghai, 1903) gives the imports at 315,363,905 haikwan taels (a haikwan tael was worth 63 cents American gold in 1902), and exports, 214,181,564 haikwan taels. Since 1890 the imports have increased every year, excepting in 1900, and the exports have shown steady increase, except in 1896, 1898 and 1900. The imports have much more than doubled since 1890, and the exports have nearly trebled. Hong Kong, Great Britain, Japan, the United States, India, and Russia figured most largely in the trade in this order.

Customs Districts and Lighthouses in China.—The Inspector General of Customs at Shanghai has just published the revised list of the lighthouses, buoys, and beacons on the coasts and rivers of China, the pamphlet including 9 charts showing position and kind of lights and limits of Customs districts. In China proper there are 17 Customs districts and 9 lighthouses.

Argentine Wool.—France continues to be the largest consumer of Argentine wool. In the fiscal year 1901–02 Argentina exported 505,086 bales, of which 225,000 bales entered France through the

ports of Dunkirk, Havre, and Marseilles. Germany received 127,000 bales through Hamburg and Bremen; Belgium 78,000 bales, and England 35,000 through Liverpool and London. The exports to North America were 34,000 bales.

ARGENTINE FOREIGN TRADE IN 1902.—The imports of Argentina in 1902 were valued at $103,039,256 in gold, a decrease of $10,-920,493 as compared with 1901. The exports were $179,486,727 gold, an increase of $11,770,625 as compared with 1901. The leading imports in order of value were: textiles, $29,744,239; iron manufactures, $17,916,082; pottery, $10,908,694; provisions, $10,-626,004; wood and wood manufactures, $6,856,776; beverages, $5,583,549. The purchases from Great Britain were worth $36,-955,460; Germany, $13,229,275; United States, $13,303,504; Italy, $12,265,003; France, $9,243,071; Belgium, $5,484,233; Brazil, $4,583,645. The largest buyers of the meat, grain, hides, and other products of Argentina were: Great Britain, $35,084,066; France, $29,587,457; Germany, $22,939,881; Belgium, $13,760,219; United States, $10,037,576, and Brazil, $8,368,742. (*Revista Financiera y Comercial*, Buenos Aires, Feb. 6, 1903.)

RAISING CROPS IN THE FAR NORTH.—Mr. N. L. Skalosubof, addressing the recent agricultural convention at St. Petersburg, said that many facts may be given to disprove the popular idea that grain will not ripen north of 60° N. Lat. A clergyman at Yugansk, Siberia, 61° N. Lat. and 73° 40′ E. Long., is building a mill propelled by wind-power to turn his winter rye and spring wheat into flour. At Masau, on the Pelym River, in 61° N. Lat., a farmer has extended his area under tillage, so that he now raises all the grain required by his large family, and has a surplus to sell. The efforts to raise rye at Beresof in 63° 54′ have been very successful. Still farther north, in 64° 13′, barley, rye, and oats have been grown for a series of years, and yield fifteenfold. Vegetables are raised at the most northern line of Russian settlements—for example, at Obdorsk in 66° 31′, where the successful experiment was first made in 1894.

GENERAL.

GEOGRAPHEN-KALENDER.—Justus Perthes has begun the publication, at Gotha, of an annual "Geographen-Kalender," a reference book of about 450 pages, which promises to be very useful to all geographic workers. Its timeliness and usefulness may be seen from the following enumeration of the more important depart-

ments: Geographical tables, such as those for finding the value of map scales, or for expressing thermometrical records in terms either of Fahrenheit, Celsius, or Réaumur; an enumeration of the chief geographic events, the results of exploration, the geographic literature, and geographic education in 1902; a list of geographers who died in 1902; the latest statistical information from all lands, and, finally, an address book containing the names, geographic specialties, and addresses of about 5,000 workers in this field. The volume ends with sixteen handsome little maps, illustrating, cartographically, the most important geographic events of 1902. Dr. Herman Haack is the editor, his assistants being Dr. Wilhelm Blankenburg, Professor Paul Langhans, Professor Paul Lehmann, and Hugo Wichmann. Next year's edition is to contain a list of geographic societies and publications.

Bibliotheca Geographica.—Vol. VIII of *Bibliotheca Geographica*, published by the Berlin Geographical Society, and compiled by Mr. Otto Baschin, is a practically complete index to the geographic literature and cartographic products of 1899. It contains 511 pages, the volume for 1897 having 444, and that for 1898 478 pages. The regular growth in size of the annual volumes of this most helpful bibliography indicates both enlargement of the quantity of geographic material and the increased thoroughness with which Mr. Baschin, year after year, has covered this prolific field. No necessity has arisen for changing in any volume the excellent classification adopted for the first of the series. Perhaps the only noteworthy improvement in Vol. VIII is the greater completeness with which the Russian titles are treated. As in Vol. VII, thirteen pages are devoted, in the section on Special Geography, to the United States. The classification and the indices of subjects and authors make it easy to find the references to every branch of geographic products. The Berlin Geographical Society and Mr. Baschin undoubtedly have the thanks of all geographic workers for this very useful reference book.

Spherical Maps and Reliefs.—In a paper read before the Royal Geographical Society on April 2 last, Professor Elisée Reclus deprecated the use of maps on different scales, because it is quite impossible to compare them. The maps of Java, for example, are always small and the maps of The Netherlands are large, which causes confusion in one's mind. In all well-conducted schools globes should be used and children should be forbidden to use maps. To show a globe of huge dimensions is impracticable; but

we may at least show slices of the superficial part of the earth, and the effect is the same. If, for example, we should wish to make a globe in a proportion of 1:5,000,000, it would be eight metres in circumference—too large for an ordinary room. But if we cannot have the whole globe, we may have slices of it, and then see places as they are. It would take nearly 150 slices to complete the whole globe; but 50 would represent all the continents, while the remaining 100, representing the water, would be less useful. As these slices of the globe would be only in the proportion of 1:5,000,000, it would be impossible to show relief otherwise than by colours or shades. True relief begins to be visible by slight asperities only when the proportion is from 1:1,000,000.

With regard to relief maps, the speaker said that in a reproduction of Mont Blanc in relief with the proportion of 1:100,000, the mountains would be about four centimetres above the plains. The heights would not be increased more than the breadth and the length of the country, but would exactly conform to the truth. It is wrong for makers of relief maps to show a relief which is not true in proportion. It is absolutely necessary to have an idea of geological shape. It is, therefore, essential to know the slope; but if we heighten the slope, it is impossible to imagine the reality. We get a false idea of the true shape of the country represented. If we wish to show the truth, we must give the proportions exactly as they are in nature. M. Reclus exhibited a model of one of the most precipitous parts of Belgium. This had been stamped out of copper by Mr. Patterson, an Englishman living in Belgium. Every point, M. Reclus said, was in its true position; the whole was true to nature, and such reliefs, he was sure, were a great improvement upon the reliefs ordinarily made, because less difficult to construct, cheaper, and more lasting. (Condensed from the *Geog. Jour.*, Sept., 1903.)

Syllabuses of Instruction in Geography.—The Council of the Royal Geographical Society received requests from the London School Board and the Oxford and Cambridge School Examinations Board to appoint a special committee to draw up syllabuses, as guides to instruction in geography in elementary and secondary schools. The committee requested Mr. T. G. Roper, the Government Inspector of Schools, and Mr. H. J. Mackinder, Reader in Geography at Oxford University, to draft two syllabuses—one for elementary and the other for higher schools. Owing to the death of Mr. Rooper, Mr. G. G. Chisholm completed the revision of the

elementary syllabus. The syllabuses have now been issued by the Society, in a pamphlet of seventeen pages.

The elementary syllabus deals with the preliminary stage of instruction for children between five and eight years; the foundation for systematic study for children between eight and eleven years old; geographical observations, the use of globes and maps, and systematic study of various parts of the world for children from eleven to fourteen years old. The syllabus for higher schools gives outlines of work for a four-years' course.

Having been prepared by educators of large experience, and then thoroughly discussed and, in some respects, amended by the Committee, they undoubtedly contain many suggestions of value for teachers.

A New Work on Bermuda.—The Connecticut Academy of Arts and Sciences has devoted its entire centennial volume (Vol. XI, Part II) to the work of its President, Professor Addison E. Verrill, of Yale, on the Bermuda Islands. The volume, which contains over 500 pages, especially emphasizes natural history, while treating also the scenery, climate, products, geology, people, and history of these beautiful islands. In text and illustrations the book is comprehensive and accurate, and is well adapted for a standard work of reference on the subject, and also to meet the needs of many visitors who are interested in the vegetation, the unusual forms of animal life, the grottoes, and many other aspects of the islands.

SHEETS OF THE UNITED STATES ATLAS.

BY

HENRY GANNETT.

During the past year the U. S. Geological Survey has issued eighty-six additional sheets of the great atlas of the country which it is preparing. These sheets are widely scattered over the United States, nearly half the States and Territories being represented upon them.

In the State of Maine are four sheets, all on the scale of 1 : 62,500, and with contour intervals of 20 feet. These sheets, known as the Orono, Castine, Bangor, and Bucksport, represent country bordering on Penobscot River near its mouth. They show a region of

broken, rocky hills and drumlins, with interrupted drainage, marshes, and lakes—a typical glaciated country.

The result of co-operation between the State of New York and the U. S. Survey is shown in the fact that no fewer than 20 sheets in this State were published during the past year. All of these are on a scale of 1 : 62,500, with a contour interval of 20 feet. Of these, four are in the northern part of the State, bordering on the St. Lawrence River, west of the Adirondack region, and show a country of low relief, which is mainly composed of glacial deposits. In this region the direction of the glacial movement was evidently southwestward, as is indicated by the trend of the deposits. In the Adirondacks is one sheet, Big Moose, showing a country of scattered, irregular hills, with many lakes and swamps and an interrupted drainage, the hills having a general northeast and southwest trend. On the upper Hudson, in the southern portion of the Adirondacks, is the Luzerne sheet, showing a region of rounded, irregular hills, with little apparent system. In the southern part of the State are the Norwich and Owego sheets, which show a deeply-dissected plateau, traversed by the Susquehanna River and its branches.

Seven sheets—Canandaigua, Naples, Hammondsport, Richfield Springs, Genoa, Pennyan, and Westfield—are in the Finger Lake region, or the western part of the State. Canandaigua and Naples represent the Canandaigua Lake and its surroundings. Hammondsport and Pennyan represent Lake Keuka and other small lakes in its neighbourhood; Richfield Springs the greater part of Otsego Lake; Genoa a large portion of Cayuga Lake, while Westfield lies upon the shores of Lake Erie, and shows the northern bluff of Alleghany plateau. The glacial origin of the lakes is beautifully developed on the maps, showing the smooth glacier-cut walls, as yet scarcely notched by streams.

The Kinderhook sheet represents country in the eastern part of the State, characterized by irregular or broken hills. The Broadalbin lies just north of the Mohawk Valley, and shows a country broken in the northern part; while the southern part has slight relief, and is traversed by the Sacandaga River in a circuitous course, with extensive marshes in its valley. The Cortland sheet lies in a deeply-dissected plateau in the central part of the State. On Long Island are two sheets, Northport and Babylon. These, together, show an excellent section across this morainic island, the northern portion being largely composed of broken hills, while the

southern part is a gentle slope to a low, marshy coast, outside of which are sandbars and marshy islands.

In Pennsylvania are five sheets, all on a scale of 1:62,500, with a contour interval of 20 feet. Of these Slatington, Boyertown, and Wernersville are in the eastern part of the State, and show a country of broken, irregular hills of no great relief. The Mercersburg and Everett sheets, on the other hand, lie in the main within the region of the Appalachian ridges, and illustrate excellently their characteristics. On the former are two beautiful canoe-shaped valleys, and on the latter the deeply-incised course of the Juniata River is a very interesting feature.

In Maryland are four sheets, on a scale of 1:62,500, with a contour interval of 10 feet—Deal Island, Bloodsworth Island, Crisfield, and Nanticoke. All of these are upon the eastern shore, and represent country of very little relief and extensive coast marshes—a land in process of sinking.

In North Carolina are three sheets—Parmele, Tarboro, and Kenly. All these sheets are upon a scale of 1:62,500, the two former having a contour interval of 10 feet, the last of 20 feet. All these sheets show a plain of very slight relief, with crooked, winding streams bordered by marshes.

In West Virginia there are five sheets—Milton, Fairmount, Clarksburg, Wheeling, and Guyandot—all on a scale of 1:62,500, with a contour interval of 20 feet. They lie in the western part of the State, and show the lower slopes of the Alleghany plateau, which is here very deeply dissected with irregular drainage.

In Alabama is one sheet, Wetumka, on a scale of 1:125,000, and a contour interval of 50 feet, situated in the central part of the State. It represents a portion of the course of Coosa River. It is a region of no great relief, but with hills rising generally from south to north.

In Ohio are three sheets—Canton, Fostoria, and Oberlin—on a scale of 1:62,500, the first having a contour interval of 20 feet, the last two 10 feet. The country represented upon these sheets is extremely level, with but little relief, and that due to glacial deposition.

Work has been commenced on an extensive scale in the State of Indiana, which has heretofore been almost neglected by the Survey, and among the sheets are eight in this State. Seven of these—namely, St. Meinrad, Petersburg, Velpen, Boonville, New Harmony, Haubstadt, and Princeton—are on a scale of 1:62,500, with contour intervals of 20 feet; while the eighth, Ditney, is on

a scale of 1:125,000, and also with contour interval of 20 feet. All of these sheets are in the southwestern part of the State, and show country of no great relief, but with broad valleys along the Wabash and White Rivers.

In Kentucky is one sheet only, Tell City, on a scale of 1:62,500, with a contour interval of 20 feet. Across this sheet from east to west flows the Ohio River, leaving a narrow strip of Indiana along the northern border.

In Wisconsin are two sheets, Briggsville and Geneva, on a scale of 1:62,500 and a contour interval of 20 feet. These sheets illustrate irregularly-deposited glacial detritus, with many lakes and marshes and interrupted streams.

In Iowa is one sheet, Winthrop, on a scale of 1:125,000 and contour interval of 20 feet. This is situated in the eastern part of the State, and shows a somewhat broken prairie country.

In Missouri are four sheets, all on a scale of 1:125,000, with contour intervals of 20 to 50 feet. These sheets are Edina and Kahoka, in the northeastern corner of the State, and Sullivan and O'Fallon in the eastern part. The last show a portion of the valley of the Mississippi River and the lower Missouri.

In Arkansas is one sheet, Camden, on a scale of 1:125,000, with a contour interval of 50 feet. This shows a part of the course of the Ouachita River, with the extensive low lands bordering it.

In Indian Territory is one sheet, Lukfata, on a scale of 1:125,000 and contour interval of 50 feet. This sheet is situated in the Choctaw Nation, and represents a part of the Ozark Mountains.

The Gainesville sheet lies in part in Texas and part in Indian Territory, on a scale of 1:125,000, with a contour interval of 50 feet. It is traversed from west to east by Red River, which sweeps across it by a very circuitous course, with great bends.

In western Texas, El Paso County, there is one sheet, Cerro Alto, on a scale of 1:125,000 and contour interval of 50 feet. This shows a desert country, no flowing water being found upon it. The features are the irregular, volcanic Hueco Mountains, with Cerro Alto as the culminating point.

In Nebraska is one sheet, Weeping Water, on a scale of 1:125,000 and contour interval of 20 feet. This sheet lies south of the Platte, in the eastern part of the State, showing a rolling prairie country.

Arizona has one sheet, Bradshaw Mountains, on a scale of 1:125,000, with contour interval of 100 feet. This sheet is in the

central part of the Territory, and the area is almost entirely mountainous or composed of high plateaux.

Colorado has one sheet, Greeley, on a scale of 1:125,000 and a contour interval of 20 feet. It is situated in the northern part of the State, on the plains, and is traversed by the South Platte River, flowing northward and eastward. Its valley is highly cultivated, and is intersected in every direction by irrigation ditches, and dotted with reservoirs.

Wyoming has two sheets, Aladdin and Fort McKinney, on a scale of 1:125,000, the former having a contour interval of 50 feet and the latter 100 feet. The Aladdin sheet, which lies in the eastern part of the State, bordering on South Dakota, mainly consists of plains and broken hills, rising in the western part of the sheet to mountains. The other sheet represents the eastern edge of the Bighorn Mountains, with the plains stretching eastward from their base.

In Utah there is one sheet, Coalville, on a scale of 1:125,000 and contour interval of 100 feet. This sheet is of special interest as representing the divide between the western end of the Uinta Mountains and the west flank of the Wasatch Range. It consists of a valley by the name of Rhodes, covered with gravel and small boulders, lying at an altitude of about 6,500 feet, above which the west end of the Uinta Range rises abruptly to an altitude of more than 10,000 feet. This region is drained by Weber River, flowing west out of the Uinta Mountains, and thence northward; while along the south edge of the sheet flows Provo River. The divide between the two streams is almost imperceptible, and suggests the possibility that the Upper Provo may formerly have flowed to the Weber.

Montana has two sheets, both on a scale of 1:125,000, with contour intervals of 100 feet. These sheets, Coopers Lake and Bonner, are in the western, mountainous portion of the State. Coopers Lake shows the main divide of the Mission Range, the mountains rising to altitudes exceeding 8,000 feet. Bonner sheet shows part of the drainage basin of Hell Gate River, immediately east of the City of Missoula.

Idaho has one sheet, known as Rathdrum, representing an area in the western part of the State, including most of Cœur d'Alene Lake and the southern part to Pend d'Oreille Lake. The central portion of the sheet is occupied by the Great Rathdrum prairie, evidently a basin, of which the two lakes mentioned, with numerous others, formed part, the whole being evidently of glacial origin.

In California are nine sheets, in the various parts of the State. They are upon various scales and various contour intervals. San Antonio and Rock Creek sheets represent the summit of the north slopes of San Gabriel Mountains, extending out into the Mojave desert on the north, and illustrate rather fine examples of alluvial cones. These sheets are on a scale of 1:62,500, with contour intervals of 50 feet. Santa Susana and Tejon are in the southern part of the State, and are largely comprised in the Pine Mountain and Zaca Lake Forest Reserve. Their scales are: the former 1:62,500, with contour interval of 50 feet, and the latter 1:125,000, with contour interval of 100 feet. These represent the coast ridges running rudely parallel to the coast of the west, intersected by broad valleys. The Calabasas sheet, on a scale of 1:62,500, with contour interval of 50 feet, stretches northward to the coast and directly west to Santa Monica, and represents the Santa Monica Mountains. Fernando and Corona sheets, also on a scale of 1:62,500, with contour interval of 100 feet, represent considerable areas in Southern California bordering the coast, including many towns and much rich agricultural land. The Santa Cruz sheet, on a scale of 1:125,000, with contour interval of 100 feet, shows the coast ranges from Santa Cruz to the foot of San Francisco Bay, and a part of the Santa Clara Valley. Fairoaks sheet, on a scale of 1:62,500, and contour interval of 10 feet, represents Sacramento, with the foothills of the Sierra Nevada to the east. The Randsburg sheet, on a scale of 1:62,500, with contour intervals of 50 feet, represents country about the mining camps of Randsburg and Johannesburg, in the southern desert part of the State. The topography consists of irregular mountain masses with broad desert valleys.

Besides the above sheets, the office has published special maps of mining regions. Among them are Banner Hill, in California; Encampment, in Wyoming; Park City, Utah; Terlingua, in western Texas, and Cœur d'Alene, in Idaho and Montana.

NEW MAPS.

NORTH AMERICA.

UNITED STATES.—(1) Map of the State of New York. Scale, 12 miles to an inch, showing the location of bluestone quarries. (2) Sheet of the State Topographic Survey, embracing the eastern Catskills. Scale, 1 : 62,500, or 9 statute miles to an inch, showing the location of bluestone quarries, in operation or not worked, together with the ledges of bluestone that have been opened for some distance. 1901.

These maps accompany *Bulletin* 281 of the University of the State of New York, in which the quarries of bluestone and other sandstone in the Upper Devonian of New York State are described. The name bluestone is commercially applied to the even-bedded and compact sandstone suitable for flagging and house trimmings found west of the Hudson River in southwest Albany County, and stretching southward through Greene, Ulster, Sullivan, and Delaware Counties, and as far west as Broome County, with scattered quarries still farther west. The district including Greene, Ulster, Delaware, Sullivan, and Broome Counties is most productive.

UNITED STATES.—Map of the San Juan Watershed, showing the location of Prehistoric Ruins. Scale, about 12 miles to an inch. Compiled by T. Mitchell Prudden. The New Era Printing Co., Lancaster, Pa. 1903.

This sketch map illustrates a paper on "The Prehistoric Ruins of the San Juan Watershed in Utah, Arizona, Colorado, and New Mexico," by Mr. Prudden, which recently appeared in the *American Anthropologist*, and is now reprinted. The map shows in red the situation of the numerous large pueblos, open ruins, and cliff houses that are widely scattered along the waterways of this drainage basin.

UNITED STATES.—Official Railroad Map of Kansas. Scale, 14 miles to an inch. State Board of Railroad Commissioners, Topeka, 1902.

The route of each of the railroads in the State is shown by a distinct colour, and the express companies operating over the several lines are indicated. Most of the place names, including all the railroad stations, are given.

UNITED STATES.—Department of Alaska. Scale, 50 miles to an inch. Compiled in the Engineer office of the Department of the Columbia and published by the Military Information Division of the War Department, 1902.

This small-scale map is based upon the surveys of the Coast and Geodetic and the Geological Surveys and those of the military expeditions under command of Glenn, Abercrombie, McManus, and Erickson. It should be useful to travellers and map compilers, as well as to the military service, as specially indicating railroads, wagon roads, trails, telegraph lines, post offices, and lighthouses. The forts occupied on Sept. 1, 1902, are shown.

UNITED STATES.—California. Scale, 26 statute miles to an inch. Southern Pacific Railrcad Co.

This is a folder map with an index by which any place-name may readily be found. Letterpress covering the back of the map gives much condensed and recent information with regard to the geographic resources and industries of the State. It is one of the better kind of folder railroad maps, which would, however, give a more complete idea of the regions they depict if advantage were taken of the comparatively large

scale to indicate topography adequately, as is done in many similar publications of Germany.

UNITED STATES.—Map of the State of Washington, showing Classification of Lands. Scale, 6 miles to an inch. By Geo. H. Plummer, F. G. Plummer, and J. H. Rankine. United States Geological Survey, Washington, 1903.

This map accompanies Professional Paper No. 5 on "The Forests of Washington." It is printed in nine shades, which are used to show the distribution and value of the forests, such as the cut, timberless, and burned areas, and the estimated yield per acre of merchantable timber. The total amount of timber in the State under the Washington lumbering practice is estimated at 195,688 million feet B. M. Of this amount nearly 9-10ths, or 175,120 million feet, are west of the crest of the Cascade Range. The remainder, 20,568 million feet, is upon its eastern slope and in the northern and eastern parts of the State. West of the Cascade Range the country is heavily forested. East of it the land is mainly without timber.

UNITED STATES.—Map of the State of Oregon, showing the Classification of Lands and Forests. Scale, 12 miles to an inch. Prepared by Gilbert Thompson from information obtained by A. J. Johnson, United States Geological Survey, Washington, 1903.

The map accompanies Professional Paper No. 4 on "The Forests of Oregon." The information it presents is similar to that in the map of Washington above mentioned. The northern limit of red wood is in the extreme southwestern corner of the State. The burnt areas are shown to be very extensive, and are largest and most frequent in the western and more heavily-timbered part of the State.

CANADA.—(1) Assiniboia. Scale, 1:792,000, or 12.5 statute miles to an inch. By James White, Geographer of the Department of the Interior, Canada, 1903.

(2) Saskatchewan. Of the same scale, origin and date.

These maps show the extent of the Land Office surveys. Nearly the whole of the public area in Assiniboia has been plotted, and the survey is far advanced in the south central part of Saskatchewan and along most of the course of the North Saskatchewan River. The boundaries of the land districts and the location of the land offices are indicated in red. The Saskatchewan sheet is especially interesting because it is one of the regions which are now attracting many immigrants into Canada. The projected extension of the Canadian Pacific and Canadian Northern Railroads to meet the needs of this new region now opened for settlement are shown. Both railroad companies will construct branches to Prince Albert on the North Saskatchewan; and other extensions further west will traverse the valley of that river for a long distance.

CANADA.—Northern part of the Dominion of Canada. Scale, 1:3,500,000, or 55.23 statute miles to an inch. The *Geographical Journal*, London, August, 1903.

Illustrating the Journey of David T. Hanbury in 1901–1902 from Great Slave Lake down the Ark-i-Linik tributary of the Dubawnt River and across the Barren Lands to the Arctic Ocean. The nature of the country along the route north and also between Coronation Gulf and Great Bear Lake and the Eskimo camps along the Arctic coast is indicated.

SOUTH AMERICA.

BRAZIL.—Topographic map of the State of São Paulo, Brazil. Orville A. Derby, chief, and H. E. Williams, topographer. 1902 (Preliminary Edition).

In the past three years eleven folios of this map have been completed, and are most welcome, as evidence that the scientific mapping of Brazil is making some

progress. The folios are on a scale of 1:100,000, or 1.5 statute miles to an inch, each folio including an area embraced within 30′ of latitude and longitude. The contour intervals are 25 metres. The drainage is in blue, and wagon, railroad settlements, and other cultural features in black. The maps, produced at São Paulo, are very creditable.

NICARAGUA.—Scale, 1:792,000, or 12.5 miles to an inch. Prepared from official and other sources in the International Bureau of American Republics, Washington, 1903.

Shows the limits of steamer or canal navigation on many of the rivers, the location of gold and silver mines, the chief roads and stage lines, and considerable other information not seen on many atlas sheets. The boundary between Nicaragua and Costa Rica is delineated as finally agreed upon by the two countries.

EUROPE.

GERMANY.—Die Bevölkerungs-Dichtigkeit nach dem Ergebnis der Volkszählung vom 1 Dezember, 1900. *Statistisches Jahrbuch* für das Deutsche Reich. 1903. Berlin.

A map in 10 tints, representing the varying degrees of density of population in Germany according to the census of 1900.

GERMANY.—Die evangelische und katholische Bevölkerung im Deutschen Reich am 1 Dezember, 1900.

Shades of green show the areas in which Catholics and blue those in which Protestants predominated in Germany on December 1, 1900; the tints also showing the percentages of Protestants in the total Protestant and Catholic population.

GERMANY.—Die Forsten und Holzungen im Jahre 1900. Scale, 1:5,000,000, or 78.9 statute miles to an inch. Imperial Statistical Office. Vierteljahrshefte zur Statistik des Deutschen Reichs. Ergänzungsheft zu 1903, II. Berlin.

Three maps showing (1) the proportion of the entire area in each German State under forest; (2) the percentage of the forest area in each State covered with deciduous trees; and (3) the percentage of the forest area in each State covered with conifers.

SCOTLAND.—Bathymetrical Survey of the Fresh-water Lochs of Scotland. Scale, 1:21,120, or 1 mile to 3 inches. By Sir John Murray and others. The *Geographical Journal* and the *Scottish Geographical Magazine*, London and Edinburgh, September, 1903.

These maps, devoted to the lochs of Tay basin, are a part of the results of the bathymetrical survey of the fresh-water lochs of Scotland, which is now being carried out under the direction of Sir John Murray and Mr. Lawrence Pullar. Thirteen lochs are shown on the eight map plates, including Lochs Rannoch and Earn, which are among the larger and more important lochs of the Tay basin. The contours of the lake bottoms, shown in colours, were ascertained by 2,743 soundings, the average number of soundings per square mile of water surface being 180. The contours of the surrounding land surface are reduced from the 6-inch Ordnance Survey Charts. The cartographic results of these water and land surveys have been finely reproduced by Bartholomew on these map sheets. Longitudinal and cross sections of the depths are drawn for each loch.

NORWAY.—Geologic Map of Bergen and its Environs. Scale, 1:25,000, or 0.39 mile to an inch. By Hans Reusch. *Aarbog* of the Bergen Museum, No. 3, 1903. Bergen.

Illustrating a paper by Mr. Reusch on the geology of the city and its neighborhood.

AFRICA.

German East Africa.—Übersicht der geologischen Ergebnisse der Reisen der Berg-assessoren Bornhardt und Dantz, 1895–1900. Scale, 1:2,000,000, or 31.5 statute miles to an inch. Mitteilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten, Vol. XVI, No. 2. 1903.

Sixteen colours are used to show the surface geology of German East Africa as far as observed during the extensive journeys of Messrs. Bornhardt and Dantz in most parts of the country. A large amount of geographical information also given is very clearly shown.

East Africa.—Grenzen in Ostafrika. Scale, 1:12,000,000, or 189.3 miles to an inch. *Deutsche Rundschau für Geographie und Statistik*, Vol. XXV, No. 10. 1903. Vienna.

Showing the boundaries between Abyssinia and the surrounding possessions of Great Britain, Italy, and France according to treaties concluded from 1900 to 1902.

Lake Chad.—Territoire Militaire du Tchad. By Captain Bézu. Scale, 1:2,500,-000, or 39.4 statute miles to an inch. *Revue de Géographie*. July, 1903. Paris.

A sketch map of the region of Lake Chad and the Shari river, showing the itineraries of the French troops and exploring detachments in 1900–02 between the north side of Lake Chad and the Mobangi tributary of the Congo. These routes are numerous, covering a large area of new territory, and are dotted with many scores of new settlements not hitherto indicated on maps. The map will be useful as showing at a glance the routes of the French expeditions, whose new contributions to the geography of inner Africa are to be published in a series of monographs.

Rhodesia.—Southern Rhodesia. A map showing the gold Districts of Mashonaland and Matabeleland. Scale, 65 statute miles to an inch. *Reports* on the Administration of Rhodesia, 1900–1902, British South Africa Co.

Mining districts, chief mines and railroads completed, building or projected, are shown.

Rhodesia.—Southern Rhodesia. A map to illustrate the Rhodesia railroad system. Scale, 80 statute miles to an inch. *Reports* on the Administration of Rhodesia, 1900–1902, British South Africa Co.

Shows all stations along the railroad line; also telegraph and telephone lines.

Rhodesia.—North Eastern Rhodesia. Scale, 65 miles to an inch. *Reports* on the Administration of Rhodesia, 1900–1902, British South Africa Co.

This map, accompanying the report on Northeastern Rhodesia, shows administrative division, telegraph and post offices, roads and places where a judicial officer resides. The boundaries and positions of places are only approximately correct.

ASIA.

China.—South Western China. Scale, 1:2,000,000, or 31.56 statute miles to an inch. The *Geographical Journal*, London, August, 1903.

This map, illustrating a paper by Capt. C. H. D. Ryder, R.E., showing the Chinese province of Yunnan and the surrounding regions, was reduced from 34 sheets of the frontier surveys now being published under the direction of the Surveyor-General of India, on a scale of 4 miles to an inch. This material was supplemented in parts by the route surveys of various explorers. The map contains a far larger number of place-names in this still inadequately-explored region than any earlier publication.

COREA.—Geotectonic Map of Korea. Scale, 1 : 2,000,000, or 31.5 statute miles to an inch. Compiled and transliterated by B. Kotô, Ph.D., *Journal* of the College of Science, Imperial University, vol. xix, Tokyo, 1903.

Giving the geologic, structural lines—lines of dislocation and folding.

ATLASES.

STIELER'S HAND-ATLAS.—Neue, neunte Lieferungs-Ausgabe. 100 Karten in Kupferstich. 17 und 18 Lieferungen. Gotha, Justus Perthes. Price, 60 pf. for each part, containing 2 map sheets.

This double part contains 4 sheets. Nos. 17 and 18 are revisions of plates 1 and 2 of Vogel's map in 4 sheets of Austria-Hungary, on a scale of 1 : 1,500,000, or 23.67 statute miles to an inch. Their beauty and legibility are increased by the new process of production. The mountain features are more sharply defined by the greater contrasts between light and shade. No. 38 is the new plate of the southern part of Great Britain, on a scale of 1 : 1,500,000, in which, without sacrificing clearness of topographic delineation, the place-names are at least four or five times as numerous as in the earlier map. The nomenclature is in English, while the map it replaces had many German spellings, as "St. Georges Canal" and "Irische See." No. 58 is also a new map, giving East Siberia and Manchuria, by Habenicht. The scale, 1 : 7,500,000, or 118.3 statute miles to an inch, is nearly three times as large as that on which this territory has been presented in earlier editions of this atlas. The result is that the map gives an unequalled idea of the geography of East Siberia. This sheet completes the two-sheet map of Siberia in the new edition of this atlas.

Atlas Colonial Português. Ministerio da Marinha e Ultramar. Lisbon, 1903.

Though these 11 sheets, in colours, are not of a high order of cartographic excellence, the scale, in some instances, is large, so that more detail is given than in many good atlases.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, Sept. 16, 1903.

The first meeting of the Committee appointed by the Seventh International Geographical Congress at Berlin, in 1899, to consider a scheme of sub-oceanic terminology may find a place here, though held at Wiesbaden. M. Julien Thoulet made a report on the subject of a map of the ocean depths, and the Prince of Monaco, who presided, announced that he assumed the cost of this map, which is to be brought out, with the collaboration of the hydrographic services of the world, by the Oceanographical Museum of Monaco. The map will be on a scale of 1:10,000,000, on Mercator's projection from 72° south to 72° north, and on the gnomonic projection for the polar ice-caps. The plan of the map is to be submitted to

the Eighth International Geographical Congress at Washington, in 1904.*

The twenty-fourth session of the Congress of French Geographical Societies was held at Rouen, in August, under the auspices of the Norman Geographical Society. Besides papers on subjects of general geography there were many studies of Normandy, and especially of its coasts. The meetings were well attended, and the session was closed by an excursion to London, where the visitors enjoyed the hospitality of the Royal Geographical Society.

The French Association for the Advancement of Science met at Angers, also in August. In the Geographical Section communications to be noted were those of M. Jean Brunhes (On Irrigation in Moist Countries, with the Limousin as type of a Moist Temperate Region and Java as type of a Moist Tropical Region), of Dr. Dufour (On Bee-Culture in France), and Dr. Raulin (On the Forests of Southern Madagascar). Attention may be called to Prof. Bigot's paper on the Drying-up of Valleys in Calvados, and to that of MM. Bernard Brunhes and David on the curious Magnetic Anomaly between the eastern and the western slopes of the Puy-de-Dôme.

Very interesting was a discussion of several memoirs on the subject of whirlpools and cyclonic movements. M. Jean Brunhes analysed the studies of three writers (MM. Emile Chaix, Squinabol, and Dal Piaz) on the *oules* † of the Valserine, the *chaudrons* † of the Brenton, the *Marmites* † of the Mas, etc., and explained his own researches on the work of whirlpools in the erosion of valleys. M. Bernard Brunhes thought it possible to find a connection between the rotation of the earth and the predominance of whirlpools moving directly, like whirlwinds, and perhaps a confirmation of the celebrated law of De Baer on the deviation of water-courses towards the right. M. Fabre spoke on the dissymmetry of river valleys, and M. Bruyant on the *seiches* of Lake Pavin and his verification of Forel's formula, made for the first time on a lake in the central *massif* of France.

An interesting experiment made by M. Louis Olivier, of the *Revue Générale des Sciences*, is to be recorded. He is organizing cruises, or excursions, of commercial reconnaissance, the first of which is to visit, in the month Oct. 13–Nov. 17, the principal ports of the eastern Mediterranean. Lectures will be given by specialists on the economy, the riches, the resources, and the tariffs of the

* It is announced that work on the map is begun, and will be carried on without waiting for the meeting of the Congress.

† Local names for the cavities known as pot-holes or giants-kettles.

countries visited, the habits and commercial usages and the wants of the inhabitants, and the passengers will have an opportunity of visiting at each seaport the establishments which particularly interest them.

In the last report of the Paris Observatory there is much to reward geographers, as well as other students. It is especially gratifying to note that the co-operation of the two observatories, Paris and Greenwich, has determined with absolute precision the difference of longitude between the two meridians within the hundredth part of a second of time.

With the degree of our acquaintance with countries varies the study devoted to them. M. Henri Bresson offers an illustration of this fact in undertaking to determine, for that part of Western France known as the Norman Switzerland,* the geographical distribution of the hydraulic forces; or, as he expresses it, the *green coal.* The *white coal* of our mountains takes its name from the glaciers; the *green coal* is the name given by M. Bresson to the water which comes from the grassy plateaux, the elevated meadows, and the forests. His painstaking studies of this extensive region have enabled M. Bresson to produce very valuable maps of the water resources of nearly all Norman Switzerland.

Exploration is active in Africa. Dr. Maclaud, of the Franco-Portuguese Commission, is at work upon a map of the frontier on a scale of 1:100,000.

Capt. Lenfant, the explorer of the Niger, is now at the head of an expedition organized by the Geographical Society, the Academy of Inscriptions and Belles-Lettres, and the Ministry of the Colonies. He is to ascend the Forcados to the Niger, then to enter the Benue and reach the Tuburi swamp and the Logone, and, finally, Lake Chad. This important expedition will have for a practical result the survey of a water-route uniting Lake Chad with the Atlantic. Capt. Lenfant reached Lokodja, at the confluence of the Niger and the Benue, on the 11th of August. He expected to be at Garossa on the 23d, and he hoped (if navigable channels really exist between the Benue and the affluents of the Chad) to arrive at the lake about the 15th of September, or in sixty days after leaving Paris. This would be a result of the greatest economical importance; for the ton of merchandise would cost for its transport from Bordeaux to Lake Chad only 450 francs, while by way of the Congo it now costs 2,250 francs.

* Including the Departments of Calvados, Orne, Eure, Eure-et-Loir, Sarthe, Mayenne, and, in part, of Maine-et-Loire and Manche.

M. Perdrizet has just completed his reconnaissances and passed from the Ubangi to the Shari by the Fafa (previously unexplored in its middle and upper course) and the Bahr Sara; and he has made a survey of his route on a scale of 1:50,000.

In Eastern Africa M. Alluaud will study the geology and natural history of the country between Mombasa and the Victoria Nyanza and Mount Kilimanjaro.

In Asia Lieut. Grillères has undertaken an exploration of the bend of the Yang-tsze, made more difficult for a time by the troubles in Yunnan. He proposed to travel on foot and to continue his journey to the west and make an attempt to enter Tibet.

M. Giraud is engaged in Martinique in the study of the Montagne Pelée and the changes of the shores.

Mention must be made of Dr. Charcot's departure for the Antarctic, accompanied by M. de Gerlache and a number of specialists.

Among recent geographical publications attention must be called to one by M. Jean Brunhes, printed in the *Memorie della Pontificia Accademia dei Nuovi Lincei.* This is a study on the work of whirlwinds in rock sculpture, and the author's conclusion is that *revolving winds constitute the most active and the most irresistible form of attack in the great operation which everywhere and incessantly tends to level the continental relief.*

Two works calling for more extended notice are the *Architecture of the Soil of France*, by Commandant O. Barré, and the *Geographical Picture of France*, by M. P. Vidal de la Blache.

A volume on Savoy, by MM. Révil and Corcelle, in the series of "Guides du Touriste, du Naturaliste et de l'Archéologue," is a good book, and with it may be consulted the memoir brought out in 1752 by the Marquis de Paulmy and lately republished by M. Henri Duhamel under the title of "A Journey of Inspection of the Alpine Frontier."

Not to be overlooked is the remarkable note contributed to *La Géographie* for July by M. Squinabol, of Padua, recording his observations on the insecure ground of Capracotta, in Molise; and M. Martel's article in *Spelunca* On the Caverns of Majorca will repay study.

As usual, there is much written about Africa. M. de Lapparen- considers in *La Géographie* for June the evidences of a Marine Fort mation of the Tertiary Age in the French Sudan. His conclusions, drawn from Col. Monteil's discovery of a fossil sea-urchin at Bilma, have been confirmed by the later discoveries of Capt. Gaden in a

dallol * at Tamaské (a military territory between the Niger and the Chad) and those of other observers in the wells of Baol near Dakar.

M. de Lapparent finds that at the time when the Lutetian Sea covered the region of Paris, North Africa formed an island comprising the elevated masses of the Aïr, the Tassili, the Ahaggar, and the Tuat, and bathed on the south by an arm of the sea coming from the Atlantic and passing by Senegambia, and on the east by the sea of Bilma. Beyond this sea rose the island, or the peninsula, of Ethiopia; and still to the eastward of this another sea, the traces of which are found in Somaliland, on the coasts of East Africa, and in Madagascar.

Capt. Lenfant's book on the Niger† is to be read with his very full Report, published in the *Bulletin de Géographie Historique et Descriptive* (No. 1, 1903).

Very full of interest is M. Superville's account (in *La Géographie* for July) of his journey between the Ubangi and N' Delle, by the Kotto River, with its map on a scale of 1:1,000,000.

These are but a few of the original papers which within the last few months have added to our knowledge of African geography.

In closing this letter I may call attention to two works of great merit—Dr. Verneau's book on the Ancient Patagonians and M. Marcel Dubois's *Géographie Générale.*

HENRI FROIDEVAUX.

The Geographical Journal for August prints (pp. 192–194) the terminology of the most important forms of sub-oceanic relief, proposed at the Wiesbaden meeting by Prof. Supan, with the English equivalents suggested by Dr. H. R. Mill, and the French by Prof. Thoulet.

The opinion of geographers is asked as to the appropriateness of this terminology (here somewhat condensed) or as to the best synonyms of the German terms.

I. THE GREATER FORMS.

1. The *Shelf* (Ger. *Schelf;* Fr. *Socle* or *Plateau continental*). This is the portion of the continental border which extends seaward from tide-marks, sinking gradually to the depth of about 100 fathoms and then suddenly falling steeply to a great depth.

Examples: The British, Sunda, and Newfoundland shelves.

2. The *Depression* (Ger. *Vertiefung*) is enclosed on all sides by elevations of the sea-bed.

(*a*) The *Basin* (Ger. *Becken ;* Fr. *Bassin*) is a depression of approximately round form.

(*b*) The *Trough* (Ger. *Mulde ;* Fr. *Vallée*), an elongated and wide depression, with gently-sloping borders. A trough may be divided by transverse elevations into basins.

* The *dallol* is a native name for *ravine*, or *dry river-bed.*

† Le Niger Voie ouverte à Notre Empire Africain.

(*c*) The *Trench* (Ger. *Graben;* Fr. *Ravin*) is also an elongated but proportionally narrow depression, with steeply-sloping borders, one of which (the continental) rises higher than the other (the oceanic). Trenches are the ends of unsymmetrical basins, and lie beside the continental border or island chains. The Cayman trench (in the Caribbean) alone runs between islands, but in its case also the borders are of unequal height. Strictly speaking, the trench is only a secondary form of the great depressions of the ocean floor, but, on account of its length, depth, and genetic importance, it may be reckoned one of the principal forms.

The extension of a trough or basin which penetrates the land or a submarine elevation either with a uniform or a gradually-diminishing depth, or which is bounded on the one side by land and on the other by a submarine elevation, may be—

(*a*) An *Embayment* (Ger. *Bucht;* Fr. *Golfe*), if wide, and of a rounded or triangular form, as, for example, the East Australian embayment.

(*b*) A *Gully* (Ger. *Rinne;* Fr. *Chenal*), if long and narrow (*e. g.*, the Faroe gully, the Norwegian gully).

3. The *Elevation* (Ger. *Erhebung*) is either entirely surrounded by depressions or is a prolongation of the continental border.

(*a*) The *Rise* (Ger. *Schwelle;* Fr. *Seuil*) is an elevation which rises gradually with an angle of only a few minutes of arc, irrespective of whether it is wide or narrow, or of its vertical development. Rises carry the chief features of suboceanic relief, so that if the ocean floor changed into dry land they would act as the main watersheds.

(*b*) The *Ridge* (Ger. *Rücken;* Fr. *Crête*) is a relatively narrow elevation, which rises at a steep angle. It is narrower than an extended rise, the distinction being clear where a rise assumes in parts the character of a ridge, as, for example, the Atlantic equatorial ridge.

(*c*) The *Plateau* (Ger. and Fr. *Plateau*) is a steep elevation of large extent, in which the length and breadth do not greatly differ.

It may rise from the depressions of the ocean floor, or form a rise (*e. g.*, the Azores Plateau).

4. A *Deep* (Ger. *Tief;* Fr. *Fosse*) is the deepest part of a depression (*e. g.*, the Nero Deep).

A *Height* (Ger. *Höh;* Fr. *Haut*) is similarly the highest part of a rise, ridge or plateau, if it does not belong to the base of an island or is classed as an independent minor form.

II. Minor Forms which are of smaller extent, but on account of steeper slopes clearly distinguished from their surroundings, include—

1. Elevations:

(*a*) Elongated elevations usually of irregular surface: Ridges.

(*b*) Single elevations or submarine mountains, particularly—

(α) The *Dome* (Ger. *Kuppe;* Fr. *Dôme*), an elevation of small area, but rising with a steep angle to a depth of more than 200 metres from the surface.

(β) The *Bank* (Ger. *Bank;* Fr. *Banc*), rising to within 200 metres of the surface, but not so far as within 11 metres.

(γ) The *Shoal* (Ger. *Grund;* Fr. *Hautfond*) and *Reef* (Ger. *Riff;* Fr. *Récif*), which come within 11 metres of the surface and are dangerous to shipping.

2. Depressions:

(*a*) The *Caldron* (Ger. *Kessel;* Fr. *Caldeira**), a more or less steep depression of relatively small extent.

(*b*) The *Furrow* (Ger. *Furche;* Fr. *Sillon*), a valley or channel-like hollow in the continental border, and more or less at right angles to it.

* It is not explained why this Portuguese word is offered as French.

LATITUDE AND LONGITUDE OF CHENGTU-FU.

CHENTU, CHINA, 8/22/1903.

Editor American Geographical Society Bulletin,
New York.

DEAR SIR:

As Chentu is one of the Provincial capitals of China, and a city of possibly 500,000 inhabitants and a centre toward which both miners and traders are looking, it is possible that the data, so far as known, for its location would be acceptable to your paper.

Latitude determined from about 20 observations of stars on Meridian, both North and South, Methodist Episcopal Mission compound = L. 30° 39′ 19″ N.

Longitude determined by moon culminations, with transit theodolite—14 sets during August, 1903, place same as latitude. λ—6h. 57m. 28s. East from Greenwich (Long. 104° 22′ East).

Magnetic variation = 5′ west determined with theodolite.

Should I get different determination for longitude I will advise you.

Yours truly,

J. F. PEAT,
Missionary, M. E. Church.

According to Longman's Gazetteer, Chengtu-fu is in N. Lat. 30° 45′, Long. 104° 10′ E. Vivien de Saint-Martin's *Nouveau Dictionnaire* places the city in 30° 40′ 41″ Lat. N. and Long. 101° 50′ 30″ E. from Paris = 104° 10′ 44″ E. from Greenwich.

BOOK NOTICES.

The two volumes which contain the account of the Duke of the *Abruzzi's attempt upon the North Pole are, to me, the most interesting and attractive of any of the recent Arctic narratives.

From the second paragraph of the introduction—

> The practical use of Polar expeditions has often been discussed. If only the moral advantage to be derived from these expeditions be considered, I believe that it would suffice to compensate for the sacrifices they demand. As men who surmount difficulties in their daily struggles feel themselves strengthened for an encounter with still greater difficulties, so should also a nation feel itself still more encouraged and urged by the success won by its sons to persevere in striving for its greatness and prosperity—

to the last sentence of the Duke's dispatch to King Victor Emmanuel—

> The steadfast courage and determination manifested by the leader of the sledge expedition and by all those who composed it, in spite of immense hardships, assured its success, and acquired fresh glory for our country, by making its flag wave at the highest latitude which has hitherto been reached—

the narrative breathes the spirit of modest determination and effective self-reliance.

Though not as widely heralded either before, during, or after as the expedition of his predecessor Nansen, Abruzzi's expedition was a striking success. The very quietness, effectiveness, and celerity with which his work was accomplished militated against its attracting as much attention as Nansen's protracted voyage. The world did not have time to get uneasy or curious in regard to Abruzzi before he was back again with his work accomplished.

He was fortunate in forcing his ship quickly, and with comparative ease, beyond the northern extremity of Franz Josef Land—a feat not accomplished by any of his predecessors in that region.

The mishap to his ship, following almost immediately after, leaving her forced against the shore and, as it was thought, rendered unseaworthy, only served to bring out strongly the courage and resourcefulness of Abruzzi and his companions.

The successful northing attained by the ship was fittingly

* On the "Polar Star" in the Arctic Sea. By His Royal Highness Luigi Amedeo of Savoy, Duke of the Abruzzi. With the Statements of Commander U. Cagni upon the Sledge Expedition to 86° 34′ North, and of Dr. A. Cavalli Molinelli upon his return to the Bay of Teplitz. Translated by William Le Queux. In two volumes, with 212 illustrations in the text, 16 full-page photogravure plates, 2 panoramas, and 5 maps. 8vo. London, Hutchinson & Co., 1903.

capped by the bravery of Cagni and his men in making their departure from the land in the following spring in spite of the most trying obstacles of open water, young ice, and the moving pack, and by their dogged persistency in pushing their way to the highest latitude yet attained in the central polar basin.

It must have been a source of the liveliest regret to Abruzzi—a regret which is shared by the writer—that an accident to himself in a preliminary sledge trip prevented him from commanding this northern party.

On the other hand, it is a source of the most intense satisfaction, for the sake of the men themselves, of Abruzzi, and of the cause of Arctic Exploration in general, that the loss of Cagni's party—a loss which would have made the Expedition a complete catastrophe, instead of a splendid success—was averted, though literally almost by a hair's breadth.

The observations and results of the expedition are valuable.

Cagni's journey straight away north, 326 miles as the crow flies, from C. Fligely, dissipated completely the penumbra of uncertain islands which has surrounded Franz-Josef-Land since Payer and Weyprecht's visit, and defines the group sharply and clearly as an archipelago of moderate size, its northern shores lying third in order of proximity to the Pole.

The expedition was particularly valuable, in my opinion, in that it eliminated from further consideration the so-called Franz-Josef-Land route to the Pole.

It is interesting to note that of the various explorers of Franz-Josef-Land, viz.: Payer and Weyprecht, Leigh Smith, Jackson, Wellman, Baldwin, and Abruzzi, the last is the only one who succeeded in pushing beyond the northern headland of the archipelago.

In view of this fact Abruzzi's remarks upon the subject of the attainment of the Pole are particularly valuable as well as extremely interesting. His words are given in full:

> It would be useless to repeat the attempt [of reaching the Pole] by following the same plan [the route from Franz-Josef-Land]. It would, at most, be possible to push a few miles further towards the north, if the ice on the Arctic Ocean was in an unusually favourable state ; but the results would not afford any compensation for the fatigue and the privations undergone. While following, therefore, the invariable plan of setting out from some point on land, and not from a ship drifting in the ice, on account of the reasons put forth in the first chapter of this work, it will be necessary to find some other method of shortening the distance which has to be travelled with sledges. What I should recommend would be to sail along the western coast of Greenland to the north of Kennedy Sound, where it ought to be possible, under favourable conditions, to go to a still higher latitude than that reached by the *Alert* off Grant Land. * * *

The weight of the load carried by the sledges should not be calculated according to what the men and dogs can draw, but according to the limitations imposed by the unevenness of the ground over which the march must be performed. On ice in the neighbourhood of land, the weight of the load, together with that of the sledge, must not be over 550 lbs. * * *

It should be remembered that, no matter from where the start may take place, there will always be a belt of very difficult ice in the vicinity of land. * * *

This belt of rugged ice, as was observed when Cagni's expedition set out, may be looked upon as extending about 120 miles from the coast. * * *

Greenland possesses the following advantages over Emperor Franz Josef Archipelago. The funnel formed by the northern opening of Robeson Sound and Grant Land to the west, and Greenland to the east, must stop the movement of the ice towards the south in spring, when the expedition would be on its way towards the north, and would thus prevent the drift which reduced the length of Cagni's daily marches so much, especially during the period of the expedition.

Emperor Franz Josef Archipelago forms a triangle, with its summit towards the north, and is, therefore, difficult to find; and what happened to Cagni * * * might happen to any detachment that wanted to reach the camp on Prince Rudolph Island. This danger does not exist in Greenland, * * * and if the expedition deviated from its course when returning, it would easily find the camp by following the coast."

Abruzzi has arrived independently, completely, and clearly at my own views. I regret that he could not have combined with his intelligent preparation and courageous push my own years of experience in equipment, icecraft, and management of dogs. Could this combination have been possible, while Abruzzi would not have reached the Pole he could have increased his already splendid march by at least a hundred miles.

There is another aspect of Abruzzi's expedition which is instructive—the example which he has given to young men of wealth and leisure all over the world to devote their time and their money to adding something to the store of the world's knowledge and attaining for themselves an honorable and commanding reputation, rather than waste both time and money in pursuit of amusement, or worse.

Altogether, Abruzzi himself, and his expedition, possess a striking personality. The expedition will last long in the annals of Arctic effort, and the Duke has proved himself well worthy of the traditions of the House of Savoy.

The style of the narrative is effective—it is simple, modest, clear, and direct. There is no padding; there is no space wasted in communing with the infinite, or in word-painting. Finally, Abruzzi has been fortunate in his translator, and the book is almost entirely free of the peculiarities which often unfavorably impress one in reading books translated from a foreign language.

R. E. PEARY.

Central Europe. By Joseph Partsch, Ph.D., Professor of Geography in the University of Breslau. With Maps and Diagrams. In The Regions of the World Series. Edited by H. J. Mackinder, M.A. D. Appleton & Company, New York, 1903.

Professor Partsch's contribution to this series is a very interesting volume. The territory he describes extends from the North and Baltic Seas to Turkey, or, in other words, it embraces Belgium, the Netherlands, and Germany in the north, Switzerland and Austria-Hungary in the centre, and Montenegro, Servia, Rumania, and Bulgaria in the south. Over this very large region he travels again and again, describing it in its various aspects. To profit most by its perusal the reader should follow the text with a good atlas. The considerable number of small maps scattered through the book are very useful for their special purposes; but few books have recently appeared which will so well repay careful reading with a first-rate atlas at hand. Such a book as this and good maps for constant reference help one another. Both are illuminative; and each aids the other to impart to the mental vision a clear and accurate view of the things described and their relations. The book may well be recommended to any mature student to be read in this way, securing at once a fine, thorough, geographic study and excellent drill in map reading.

The first seven chapters are given to a concise treatment of the physical history and present physical condition of Central Europe, interesting because the author has imagination as well as scholarly attainments, and all the more interesting if read, or rather studied, with much care; for work of this sort may not prove to be remarkably edifying to those who do not understand each statement both in itself and also in its relation to the context. The essentially continental climate is depicted in its normal conditions, its sharp contrasts, and its striking departures from the normal, as exhibited in Herzegovina. The great movements and migrations of the peoples which may be traced with certainty only for twenty centuries are described. Only one chapter is given to the political development of these States, and thus little more than a general glance at their conformation is possible.

Forty-two pages are devoted to the most striking facts of economic geography. This chapter exhibits strongly a noteworthy characteristic of the entire volume, or, in other words, a dominating feature of its plan, without which so much ground could scarcely be covered successfully in 358 pages. Minutiæ are rigorously repressed, and attention is centred upon the essential, vital features

of the topic. Thus the space given to cattle is less than two pages; but the part of cattle in the economy of Central Europe, the marked differences between these animals in the Baltic peninsula, on the North German plain, and among the central mountain pastures, with the differing purposes for which cattle are reared, are clearly brought out; and the effect of the sparsity or abundance of natural productions upon the trade relations with other lands is shown.

Chapters XII to XVIII inclusive are given to a more detailed treatment of the countries. The value of these chapters is heightened by the fact that the dominating note is the influence of the geographic environment upon the development and the material position of the various peoples. Cause and effect are everywhere closely united. The natural influences that have tended to turn the energies of the Swiss very largely into industrial channels, the water-power that gives its support to the cotton trade of Northeastern Switzerland, the topography which in that republic has nurtured the development of several independent and competing centres of intellectual and material exchange; the position of Budapest, close to the mountain regions whence come its wood and ores, its wines and building stone, and overlooking the immeasurable plains on the east, whose cereals, cattle, and horses are brought hither to market, all of which have fostered the blossoming of Budapest into one of the finest of modern cities, are examples of Dr. Partsch's able treatment of the anthropogeographic aspects of Central Europe. The volume is concluded with chapters on water and rail communication and conditions of national defence, followed by a copious index.

Each chapter in the book ends with a list of authorities in which those portions of their writings bearing especially upon the topic of the chapter are indicated. Dr. Partsch's manuscript was found to be too long for publication in an English series, and it was therefore abridged in the translation. It will be published in German in the original form.

A Guide to Belfast and the Counties of Down and Antrim. Prepared for the Meeting of the British Association by the Belfast Naturalists' Field Club. The Linenhall Press, Belfast, 1902.

Since 1874 specially-prepared guide books have usually been adjuncts of the Annual Meetings of the British Association. The topics in each hand-book are prepared by experts, and the result is a work that is very useful to the members of the Association and

also to the general public. The present hand-book describes and illustrates with many pictures the history, trade, agriculture, geology, botany, zoology, and archæology of Belfast and the adjoining counties. It will serve for years as a standard work of reference on the district. Three fine maps are included—a topographic and road map and geologic and archæologic maps.

Gazetteer of Upper Burma and the Shan States. In five volumes. Compiled from official papers by J. George Scott, F.R.G.S. Assisted by J. P. Hardiman. Printed by the Superintendent of Government Printing, Rangoon, 1900–1901.

The five volumes of this work contain more than 3,000 pages. Part I (2 volumes) is devoted to the geography, geology, history, religion, resources, and past and present systems of government. All information is given in great detail, from Burmese sources, in matters relating to the reigns of King Mindôn and King Thibaw, but chiefly from official reports, including those of members of the Geological Survey of India. The history supplied by Burmese writers is a curious document, giving little attention to events outside of the capital. It is worthy of preservation as showing the way in which the Burmese thought history should be recorded and for the light it throws upon the character and life of the last two kings of Upper Burma and the doings at their courts. Part II (3 volumes) is a Gazetteer of Upper Burma and the Shan States. It is reasonable to infer from the following typical paragraphs that no hamlet in the country has escaped mention:

HPA HSÖ.—A village in the Man Sang circle of the Northern Shan State of South Hsen Wi. It had in March, 1892, nine houses, with forty inhabitants. . . . The villagers cultivate lowland paddy.

KAK LÖN.—A Yang Lam village in the Man Hpai circle of the Northern Shan State of South Hsen Wi, situated in the rolling country west of the Loi Kawng peak. There were eight houses in March, 1892, with thirty-nine inhabitants, who cultivated hill-rice and cotton.

Important towns, rivers, mountains, etc., receive detailed treatment. Forty-three pages, for example, are given to Mandalay and the district around it. The Gazetteer contains a vast amount of information that cannot readily be obtained elsewhere, and this enhances its value as a reference book.

Le Japon, politique, économique et social. Par Henry Dumolard, pp. viii+342. Librairie Armand Colin, Paris, 1903.

During the three years Mr. Dumolard lived in Japan he had special advantages, both as Professor of French Law at the Uni-

versity of Tokio and as the head of the Commission sent to Japan by the French Ministry of Public Instruction, to become unusually well acquainted with the people and institutions of the country. His time was largely occupied with the study of the political, social, and economic conditions of Japan, and in this book he records the results of his observations. His aim was to picture the Japan of to-day, not in the superficial and minor aspects which are made so prominent in books of travel, but as a powerful empire, with an army, fleet, universities, parliament, politicians, and newspapers—a nation whose interests are closely identified with those of other countries. This volume is of the first importance in any study of Japan.

Report by His Majesty's Commissioner on the East Africa Protectorate, pp. 47. Eyre and Spottiswoode, London, 1903. Price 5d.

The British East African Protectorate lies between the Indian Ocean and Lakes Victoria and Rudolf, and between the Italian possessions and the Juby River on the north and German East Africa on the south. The seat of government is Mombasa, where the Commissioner resides. The large country is divided into seven provinces, over each of which is a sub-commissioner. The report of Commissioner Eliot contains a summary of the geography, resources, and native tribes of the Protectorate, the northwest part of which, however, is still almost unexplored; while studies of the other districts are still in progress. The Commissioner is convinced of the possibility of white colonization on the highlands or plateaux (6,000 to 8,000 feet above the sea) west of the Mau escarpment. He says the average mean temperature in this elevated region is 67° F. at 9 A.M. and 78° F. at noon; and the nights are much cooler. "Ten years' experience shows that the climate is healthy and invigorating, and that European children born in the country may live and thrive there." The Protectorate has abundant resources, and Mr. Eliot believes that tobacco and cotton especially may be cultivated on a large scale in the lowlands.

Deutschland im Stillen Ozean. By Dr. Georg Wegener. With 140 photographs and a Map in colors. Velhagen & Klasing. Bielefeld and Leipzig.

This handsome little volume is No. 15 in the *Land und Leute* series of geographical monographies. Dr. Wegener describes the Samoa, Caroline, Marshall, Ladrone and Salomo islands, Kaiser Wilhelm's Land and the Bismarck Archipelago, and his competency for the task is enhanced by the fact that in 1900 he visited all the

German possessions in the Pacific, excepting the Marshall and Salomo islands. He tells how these islands, widely scattered through Polynesia, Melanesia and Micronesia, came into the possession of Germany; describes their broader aspects in respect of geologic formation, climate, and plant and animal life, and then writes in considerable detail of each of the possessions. The descriptions are clear, comprehensive, and accurate, and lose no value from the fact that they were written for the general public. The photographs are interesting and instructive, the map is helpful, and the index renders it easy to use the work as a book of reference—and it is worthy of such use.

Yearbook of the United States Department of Agriculture, 1902. Washington, D. C., 1903.

The Bureau of Soils of the Agricultural Department has a force of over 100 men engaged in soil surveys in various parts of the country. Their work throws light upon the nature and distribution of our soils and their possibilities. The area surveyed and mapped in the fiscal year 1901–02 was 14,541 square miles, making a total up to that time of 22,623 square miles, or 14,478,720 acres. The soil maps covering this area are on a scale of 1 mile to an inch, and have been published or are ready for publication. The largest areas thus far covered by the soil surveys are: California, 2,154 square miles; Maryland, 2,180 square miles; North Carolina, 3,425 square miles; and Virginia, 1,604 square miles. The surveys are a valuable contribution to economic geography. As an example of their benefits, they have distinctly suggested, in Prince George, St. Mary, and Calvert counties, Md., the specialization of certain crops in the line of fruit-growing, trucking and general farming and dairying. The work of the Experiment Stations includes studies of climatic and weather conditions as related to plant growth; and the Department of Agriculture has introduced many new variations of crops, such as the Manshury barley, which has increased the yield of barley over a wide region; Kafir corn, introduced in 1886 as a crop for regions of scanty rainfall, the Kansas crop alone in 1899 being valued at over $6,000,000; macaroni wheats that bid fair to supply all our macaroni in a few years; Turkestan alfalfa, Sumatra tobacco, Egyptian cotton, and many other crops that are now successfully growing in this country.

Besides all the information which the *Year Book* brings annually to the farmers of this country it is a valuable source of reference for matters relating to economic and commercial geography.

Shell Heaps of the Lower Fraser River, British Columbia. By Harlan J. Smith. Vol. IV, Part IV, of Memoirs of the American Museum of Natural History. New York, March, 1902.

This memoir contains the results of Mr. Smith's exploration in 1897–98 of shell heaps along the lower Fraser River. These heaps, made up of layers of shell and other refuse from native villages, are the most extensive remains of the early inhabitants of the coast. They are found on many flats along the shore, and at the mouths of streams where the beach is smooth enough for canoe-landing. They are usually several hundred yards in length, about 30 yards wide, and 3 or 4 feet high; but some of them are miles in length, and some are 9 feet high, or more. Stumps of Douglas fir, 7 feet in diameter, standing on some of them, indicate that the top layer of these heaps is not less than 500 years old. Some skeletons and stone arrow-points, shell-beads and other objects are found in the heaps. The strata are often composed entirely of the remains of clams, mussels, oysters, and other shell fish. Vegetable mould and general refuse also make up a large part of some heaps. Mr. Smith's monogram is a description of the shell heaps, and the objects revealed by his excavations are illustrated by many woodcuts and a number of instructive photographs.

A Bibliography of Geodesy. (Second Edition.) By James Howard Gore, B.S., Ph.D., Professor of Mathematics, Columbia University. Appendix No. 8 in the Report of the Superintendent of the Coast and Geodetic Survey, 1902. Washington, 1903.

This bibliography extends from page 429 to page 787 of the *Report.* It was prepared in accordance with the request of the International Geodetic Association that a revised edition of the bibliography published in the Report of the United States Coast and Geodetic Survey for 1887 be issued. Only such works as treat directly of the figure of the earth, or such as describe operations which may be used in determining that figure, are included. In the case of the pendulum, however, "the theoretical side has also been included, in the belief that the pendulum will soon become a more important instrument, when it may be necessary to reconsider some of its theoretical features."

Vaterländische Handels-und-Verkehrsgeographie. By C. Grundscheid. viii + 179 pp. Hermann Beyer & Söhne, Langensalza, 1901.

This text-book of commercial geography is intended for commercial schools in Germany, and treats only of the mother country

and her colonies. The study is properly based upon the natural conditions affecting the production and distribution of commodities. In Part I the products of each geographic division, as the low plain of the Upper Rhine, the Baltic coast region, etc., are treated separately. Part II is devoted to a general survey of the industries and trade of the country as a whole. Part III deals with the colonies, and Part IV describes the chief raw materials imported from foreign countries. The topics, particularly the industries, are treated with unusual fullness for a text-book; but a school book on Commercial Geography limited to a single country misses the important educative element of comparison and contrast with other countries.

Hints to Travellers. Edited by John Coles, F.R.G.S., F.R.A.S. Eighth Edition, Revised and Enlarged. Vols. I and II. London, The Royal Geographical Society, 1901.

The present edition of this useful handbook has been expanded to two volumes. The first volume, entirely given to Surveying and Practical Astronomy, amplifies the earlier sections on Surveying, and includes a set of tables, by using which, with the Nautical Almanac, travellers may compute the results of their observations. In the second volume the sections on Meteorology and Medical Hints have been rewrittten and greatly enlarged; and Photography, Geology, Natural History, Industry, and Commerce, etc., have been revised. Hints on Outfit and other topics, formerly treated in the one-volume edition, are reserved for a separate pamphlet. Many explorers are compelled to limit the weight of their outfit. It is to be supposed that all suggestions most needed in their travels can be compactly presented within the present compass of this work, which still has the advantage of being lighter and smaller than some of the similar German handbooks.

The Restoration of the Ancient Irrigation Works on the Tigris; or, The Re-Creation of Chaldea. By Sir William Willcocks, K.C.M.G., M.I.C.E., Late Director-General of Reservoirs, Egypt, Managing Director of the Daina Sanieh Company. Being a Lecture Delivered at a Meeting of the Khedivial Geographical Society, Cairo, 25th March, 1903. With Two Appendices. Appendix A—Meteorological Information about Bagdad. Appendix B —An Address on "Egypt Fifty Years Hence." And Ten Plates. Cairo, National Printing Department, 1903.

Egypt is the queen of irrigated countries, but next to Egypt Sir William places the wonderful land irrigated in ancient days by

the Tigris, and he sees the resurrection of this region near at hand in the progress of the Bagdad Railway.

In ancient days there were two great systems of irrigation starting from above the final rapids of the Tigris—the Nahrwân system on the left bank, and that now known as the Dijeil on the right. In those days the Tigris was in its old bed, and the ancient Opis on its left bank bore to the delta of the river much the same relation that Cairo bears to the delta of the Nile.

These systems were magnificent, and the Nahrwân alone, when carrying its full supply, must have been capable of crippling the Tigris. Sir William declares that, for magnitude, the Nahrwân surpassed any Egyptian or Indian canal. The ruin that came upon the prosperous Chaldea was caused by the change in the course of the Tigris. With the completion of the Bagdad Railway will come the restoration of the canals and the creation of another Egypt.

Appendix A gives the temperature, wind velocity and direction, and rainfall at Bagdad for 1888, 1894, 1899–1902. The mean annual temperature ranges from 71.4 (Fahr.) in 1888 to 74.5 in 1901. The highest wind velocity is 10 miles per hour in February, 1888 and 1894, and the yearly mean for four years is three miles an hour. The rainfall was 8.4 in. in 1888, 22.2 in 1894, 3.6 in 1899, 5.7 in 1900, and 1.5 in 1901.

Sir William Willcocks is no prophet of evil. His vision of Egypt Fifty Years Hence reads like a description of the Golden Age with modern improvements, and among these two statues, one of Cecil Rhodes on the Equator, the other of Mr. Cope Whitehouse on the top of the Mesaigêga cliff contemplating the inland lake of 600 square kilometres, which will be one of the pleasure resorts of Europe.

The plates accompanying this interesting pamphlet admirably illustrate the story of irrigation on the Tigris.

Toscanelli and Columbus. Letters to Sir Clements R. Markham and to C. Raymond Beazley. With Introductory Note and Bibliography of this Controversy. London, 1903.—Toscanelli and Columbus. A Letter from Sir Clements R. Markham, K.C.B., and a Reply from Mr. Henry Vignaud. London, 1903.—La Route des Indes et les Indications que Toscanelli aurait fournies à Colomb. Lettre au Dr. Jules Mees, de Gand, qui pourra intéresser le Dr. Sophus Ruge, de Dresde, par Henry Vignaud, etc. Paris, 1903.

In these three pamphlets Mr. Vignaud reaffirms his convictions

on the subject of the Toscanelli letters and defends his position with ingenuity worthy of a better cause.

It is his misfortune to advocate a theory which must always remain, so to speak, in the clouds and beyond the reach of proof.

In his *Bibliography* in the first pamphlet he enumerates thirty papers and publications (exclusive of ninety-two minor notices) called forth in various countries in the past two years by the communications made by himself and M. de la Rosa to the Congress of Americanists in 1900, and by Mr. Vignaud's book on *Toscanelli and Columbus.* Most of these publications are favourable to the theory of the Columbus forgeries—a natural result in the case of every attempt to belittle a famous name. The spirit of the man who voted for the banishment of Aristides works in nine men out of ten; but the tenth man is not always silent, and for this reason Mr. Vignaud finds himself engaged in a controversy which he sustains with vigour, if not always with good taste. He says, for instance, on the second page of his *Bibliography*, that he made a *scorching reply* to a criticism by Signor Uzielli, who, it may be hoped, was provided with a pair of tongs. Again, Dr. Sophus Ruge is told on page 26 of *La Route des Indes* that he has but a slight acquaintance with the principles of historical criticism, and that by his intellectual culture, by the direction of his studies, and by the cast of his mind, he is incapacitated for appreciating the Portuguese and Spanish atmosphere, in which one must feel perfectly at home if he is to write anything that shall not be mere repetition about Columbus.

We cannot all do all things, and Mr. Vignaud seems to expect too much of those who are less happily endowed than himself.

ACCESSIONS TO THE LIBRARY.

July–October, 1903.

BY PURCHASE.

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Map.—[France] Manœuvres du Sud-Est en 1903. [Being portions of the Departments of Ardèche, Drôme, Gard and Vaucluse: apparently from the regular

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MAP.—Portugal Ultramarino: Cabo Verde, Guiné, S. Thomé e Principe. B. A. Ligorne. Lisboa, Avellar Machado [1900 ?] *Various scales. Size:* 26 x 18½ inches.

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Map of New Covington in St. Tammany Parish, La. P. L. Gusman, Surveyor. New Orleans, 1887. *Scale:* 8½ inches=1 mile. *Size:* 18¼ x 26⅝ inches. View of New Orleans taken from the Lower Cotton Press. Engraved on copper by B. Dondorf, Frankfort a/M. [N. Orleans] Louis Schwarz [1840?] *Size:* 26½ x 10¼ inches.

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Herbsttage in Andalusien. Von Georg Wegener. Berlin, Allgemeiner Verein für Deutsche Litteratur, 1903. 8vo.

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Carte du Katanga (Territoires Gérés par le Comité Spécial du Katanga). Dressée par H. Droogmans. Exécutée par A. De Schaepmeester. [Bruxelles?] Juillet, 1903. *Echelle:* 1 centimètre pour 10 kilométres. [2 sheets, *size:* 37⅝ x 23¼; and 37⅝ x 21 inches, respectively.]

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Report by His Majesty's Commissioner on the East Africa Protectorate. [Parliamentary Paper] *Africa No. 6, 1903.* London, H. M. Stationery Office. 8vo.

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Cenni Storici sui Lavori Geodetici e Topografici e sulle principali produzioni Cartografiche eseguite in Italia. Dalla metà del Secolo XVIII ai Nostri Giorni. *Con 12 ritratti.* Firenze, Istituto Geografico Militare, 1903. pr., 8vo.

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The Great Trigonometrical Survey of India, Vol. XVII: Indo-European Arcs from Karachi to Greenwich. Major S. G. Burrard, Supt. Dehra Dun, Office of the Survey, 1901. 4to.

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Map of the Republic of Peru. With a short description of the country, its Geographical features, etc. Under the Authority of Don Eugenio Larrabure y Unánue, Minister of Foreign Affairs. Compiled, etc., by Eduardo Higginson. Lima, 1903. *Scale:* 46 miles to 1 inch. *Size:* 28¾ x 36½. *Sheet, folded in cover.*

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One Thousand Miles Up the Nile. By Amelia B. Edwards [New York] Aldine Publishing Co., s. a. 16mo.

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Southern Rhodesia: Information for Intending Settlers. (London), British South

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Précis of Information concerning the Uganda Protectorate. London, H. M. Stationery Office, 1902. 8vo.

From Marsden Manson, Author, San Francisco, Cal.:

The Evolution of Climates. [Revised, enlarged and reprinted from the American Geologist, Aug.–Oct., 1898.] Minneapolis, The Franklin Printing Co., July, 1903. 8vo.

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Ireland and Her Story. By Justin McCarthy. London, 1903. 16mo.

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Map of Victoria, classified according to its productiveness. Melbourne, Crown Lands Department, 1901. *Scale:* 16 miles=1 inch. *Size:* 32⅞ x 23½ inches.—Map of Victoria, showing Counties, parishes and railways. Melbourne, Department of Lands, 1902. *Scale:* 8 miles=1 inch. *Size:* 62 x 43½ inches [4 sheets combined].

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The Regulation of Commerce through a Dispensing Power. Efforts of the Interstate Commerce Commission to gain Autocratic Control of the Internal Commerce of the United States. Washington, D. C., R. H. Darby Printing Co., 1903. p., 8vo.

From the Department of the Interior, Ottawa, Canada:

Maps of the Districts of Saskatchewan and Assiniboia: James White, F.R.G.S., Geographer. Ottawa, 1903. *Scale:* 12½ miles=1 inch. *Size:* 42 x 22 (Saskatchewan); 39½ x 19½ (Assiniboia).

From T. Mitchell Prudden, Author:

Prehistoric Ruins of the San Juan Watershed in Utah, Arizona, Colorado and New Mexico. (Reprinted from the American Anthropologist, N. S., Vol. 5, pp. 224–288, April–June, 1903.) Lancaster, Pa.

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Gazetteer of Upper Burma and the Shan States. By J. G. Scott and J. P. Hardiman. Rangoon, Government Print, 1900–1901. 5 vols. large 8vo.

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L'Évolution Comparée des Sables. Par Jules Girard. Paris, F. R. de Rudeval, 1903. 8vo.

From the Land Department of the Southern Pacific Railroad Company, San Francisco, Cal.:

Map of California, compiled from latest official and authentic information. San Francisco, S. Pacific R.R. Co., 1903. *Scale:* 24 miles=1 inch. *Size:* 21½ x 25½ inches.

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Commercial Geography. By Jacques W. Redway. New York, 1903. 8vo.

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A Search for the Masked Tawareks. By W. J. Harding King. London, 1903. 8vo.

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Cruising in the Carribbean with a Camera. New York, Dodd, Mead & Co., 1903. 16mo.

From the Board of Railroad Commissioners, Topeka, Kansas:

Official Railroad Map of Kansas, 1902. *Issued by the State Board of Railroad*

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From Velhagen & Klasing, Publishers, Bielefeld und Leipzig:

Deutschland im Stillen Ozean. Von Georg Wegener. *Land und Leute, XV.* Bielefeld u. Leipzig, Velhagen & Klasing, 1903. 8vo.

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La Route des Indes et les Indications que Toscanelli aurait fournies à Colomb. Lettre au Dr. Jules Mees, de Gand, qui pourra intéresser le Dr. Sophus Ruge, de Dresde. Paris, Ernest Leroux, 1903. pr., 8vo.

From the International Bureau of the American Republics, Washington, D. C.:

Map: Nicaragua. From Official and Other Sources. Prepared in the International Bureau of Am. Republics, W. W. Rockhill, Director. Washington, 1903. *Scale:* 12.5 miles to 1 inch. *Size:* 28 x 28½ inches.

From the War Department, Washington:

Map of the Department of Alaska. Projected and Compiled by order of Brig.-Gen. C. M. Randall, U. S. A., in the Engineer Office, Dept. of the Columbia, under the direction of Maj. W. R. Abercrombie, etc., by H. L. Gilbert, Jr., C. E. Washington, D. C., 1902. *Scale:* 50 miles=1 inch. *Size:* 33½ x 27 inches.

From Francis Wardlaw, Esq., New York:

Plan of Rome, containing its several additions from the time of Servius Tullius to that of its being taken by the Gauls. [London? 1800?] [Scale not given.] *Size:* 11¼ x 6¾ inches.—Pianta topografica della Città di Roma dell' anno 1836. Roma, Niccola de Antoni, 1836. *Scale:* 825 Palmi Rom.=1 inch. *Size:* 29¼ x 24½ inches.—Plan of Rome. London, John Murray, 1869. *Scale:* 7½ inches=1 mile. *Size:* 25 x 20½ inches.

From Sir William Willcocks, Author, Cairo:

The Restoration of the Ancient Irrigation Works on the Tigris, or the Re-Creation of Chaldea. . . . *Lecture delivered at a Meeting of the Khedivial Geographical Society, Cairo, 25th March, 1903.* Cairo, National Printing Department, 1903. pr., 8vo.

NOTES AND NEWS.

The First Meeting of the Society for the season of 1903–1904 will be held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, November 17, 1903, at 8.30 o'clock, P.M.

Prof. E. L. Stevenson, of Rutgers College, will address the Society on Martin Waldseemüller and the early Lusitano-Germanic Cartography of the New World.

On the 15th of December Dr. Frederick A. Cook will describe his experiences in the Exploration and Attempted Ascent of Mount McKinley, in Alaska.

The Eighth International Geographic Congress.—Credit having been given in some quarters to the American Geographical

Society for arrangements connected with the forthcoming—or Eighth—International Geographical Congress, it is deemed best to state here that this Society is entitled to no credit and assumes no responsibility in the matter.

By a rule unanimously adopted at the Congress held in London in 1895 it was ordered that the governing body of each Congress should constitute an Executive Committee to choose, at its own discretion, the place for holding the next ensuing Congress.

In conformity with this rule, the Executive Committee of the Seventh International Geographical Congress, held in Berlin in 1899, selected Washington as the place of meeting of the Eighth Congress; and the responsibility for the organization and conduct of this—the Eighth—Congress naturally devolved upon the National Geographic Society of Washington, which has entered upon its duties with energy. It has appointed a Committee of Arrangements, which has had several meetings and is, doubtless, making good progress.

The Congress will assemble in Washington early in September, 1904. A preliminary announcement, giving details of proposed sessions, classification of subjects, excursions, etc., will be printed in the BULLETIN as soon as it is issued by the Committee of Arrangements.

The officers of the Committee are: Dr. W J McGee (Vice-President, National Geographic Society), chairman; Mr. John Joy Edson (President Washington Loan and Trust Company), treasurer; and Dr. J. H. McCormick, secretary. The office of the Committee is in Hubbard Memorial Hall, Washington, D. C., U. S. A.

It is announced that members of the Congress will be entitled to participate in all sessions and excursions, and to attend all social meetings in honour of the Congress; they will also (whether in attendance or not) receive the publications of the Congress, including the final Compte Rendu, or volume of proceedings.

Membership may be acquired by payment of $5 (25 francs, one pound, or 20 marks) to the Committee of Arrangements. Ladies and minors accompanying members may be registered as associates on payment of $2.50 (12½ francs, or 10 shillings, or 10 marks); they enjoy all privileges of members except the right of voting and of receiving publications.

THE ALASKAN BOUNDARY.—The Commissioners appointed under the Convention signed at Washington on Jan. 24, 1903, which provided for a Tribunal to consist of six impartial jurists of repute judi-

cially to consider and answer questions submitted to it and thereby settle the proper boundary between Alaska and Canada, made its award in London on Oct. 20, 1903. The award was signed by Lord Alverstone and the Commissioners of the United States. The Canadian Commissioners declined to sign it.

When the United States acquired from Russia in 1867 the whole of what was then known as Russian America it was acquired with all its existing lines of demarcation. The frontier fixed by the treaty of 1825 between Russia and Great Britain remained unchanged, the United States having merely succeeded to the territorial rights secured to Russia by that treaty. Unfortunately, the treaty abounded with geographical puzzles, and the United States and Canada could not agree upon their solution.

Was it the intention of the Russian negotiators to bar British territory from the tide-waters of the North Pacific by retaining a continuous fringe of mainland which should run around the head of every indenting arm and inlet? Were there any mountains in existence such as were postulated by the treaty? What precisely was Portland Channel, which was to form part of the southern extremity of the frontier? These problems were the chief of those presented by the questions which the Tribunal was called upon to answer.

The questions submitted to the Tribunal were answered, in brief, as follows:

The boundary line between Canada and Alaska begins at Cape Muzon, the southwestern point of the Prince of Wales Archipelago.

The line extends straight eastward from Cape Muzon across Dixon Entrance to the mouth of Portland Channel.

Portland Channel is that channel which extends to the ocean from about 55° 56′ N. Lat. and passes to the north of Pearse and Wales Islands. These long islands divide the adjacent waters into two channels, and the claim of the United States was that Portland Channel passed to the south of the islands, leaving them in Alaska. The Tribunal decided against this contention, and gave the two islands to Canada; but it further decided that the mouth of Portland Channel is Tongas Channel, between Wales and Sitklan Islands. Thus the two small outlying islands, Sitklan and Kannagunut, are assigned to Alaska.

The line, passing through Tongas Channel, proceeds up the middle of Portland Channel to its northern terminus in about 55° 56′ N. Lat., and thence north between Salmon and Bear Rivers, which empty into the head of Portland Channel, to the 56th parallel.

The greatest point of dispute was whether the treaty of 1825

meant that there should remain in the exclusive possession of Russia a continuous fringe or strip of coast on the mainland, not exceeding 10 marine leagues in width, separating the British possessions from the bays, ports, inlets, havens, and waters of the ocean (the United States contention); or whether the coast mentioned in the treaty should be defined to be that of the general trend of the mainland shores without taking account of the deep inlets, the line crossing these inlets parallel with the trend of the main coast (the Canadian contention) and leaving the heads of the inlets with all their harbours in the possession of Canada. The Tribunal decides this question in favour of the United States, the line fixed being parallel to the sinuosities and not the main trend of the coast, thus leaving the entire water front in the possession of the United States.

The United States contention, further, was that the so-called Vancouver range of mountains north of Portland Channel designated by the treaty of 1825 as the boundary wherever it was not more than 10 marine leagues from the coast does not exist, and therefore was eliminated as a part of the boundary. The Tribunal decided against this contention. It indicated certain mountains between the Taku River and Mt. St. Elias as the mountains referred to in the treaty; but in the south, between the neighbourhood of the Taku River and about 57° 20′ N. Lat. the Tribunal expressed its inability, in the absence of further surveys, to indicate the mountains parallel with the coast within the meaning of the treaty.

The effect of this decision is to bring the boundary from Portland Channel to Mt. St. Elias considerably nearer to the coast than the line represented by the extreme United States claims. This part of the boundary, however, cannot accurately be designated on a map until the line has been delimited by a joint survey in accordance with the interpretation of the treaty of 1825 now given by the Tribunal.

THE FOURTEENTH SESSION of the International Congress of Americanists will take place in Stuttgart from Thursday, August 18th to Tuesday, August 23, 1904.

The subjects to be discussed by the Congress relate to:

(*a*) The Native Races of America: their Origin, Distribution, History, Physical Characteristics, Languages, Inventions, Customs, and Religions.

(*b*) The Monuments and the Archæology of America.

(*c*) The History of the Discovery and Occupation of the New World.

Membership is acquired by the payment of 12 marks (3 dollars or 15 francs) by postal money order or by check, payable to the treasurer of the Committee of Organization,

MR. THEODORE G. WARNER,
Stuttgart, Königstrasse 35.

Members have the right to vote, are admitted to all the general arrangements of the Congress, and receive the publications gratuitously.

The languages of the Congress are English, German, French, Italian, and Spanish.

MR. FRANCIS H. NICHOLS, favourably known by his work, *Through Hidden Shen-si*, published last year, is now in Western China, continuing the exploration so successfully begun in the Province of Shen-si. The American Geographical Society was able to extend some aid towards his present expedition; and it is hoped to publish in the BULLETIN, from time to time, brief notices of his observations and progress. The last letter received from Mr. Nichols was written at Chung-King, in the Province of Süchwan, on the 4th of September. He had just arrived, after a toilsome and perilous voyage of 29 days through the gorges of the Yang-tsze at the season of high water, when the current of the great river runs ten or twelve miles an hour, and the boat must be pulled up-stream along the bank.

NAMES IN THE ARCTIC.—*Science*, of October 16, publishes the following communication from Mr. Edwin Swift Balch:

TO THE EDITOR OF SCIENCE: The president of the Royal Geographical Society, Sir Clements R. Markham, in the *Geographical Journal* for July, 1905, Vol. XXII., page 7, note, says: "The land which is divided from Greenland by Smith Sound forms a long island, and as many as seven names have been given to various parts of it—1. North Lincoln, 2. Ellesmere Land, 3. King Oscar Land, 4. Schley Land, 5. Arthur Land, 6. Grinnell Land, 7. Grant Land. It is a geographical necessity that, for purposes of description, there should be a name for the whole island. It was first discovered by Baffin in 1616, and first named Ellesmere by Inglefield in 1853. Its name should, therefore, be Ellesmere Island." A map on page 57 of the same volume shows "Ellesmere Island" and omits "Grinnell Land" and "Grant Land."

It seems desirable to call the attention of American scientists and geographers to this curious proposition, which, without the slightest notice to American geographers, eliminates the American names given to the most important discoveries by Americans in the Arctic, and minimizes as much as possible any recognition of the work of Kane, Hayes, Hall, Greely and Peary.

EDWIN SWIFT BALCH.

PHILADELPHIA, October 6, 1903.

A Geographical Library for Sale.—M. H. Welter, 4 rue Bernard-Palissy, Paris, has come into possession of the library of the late Vivien de Saint-Martin, who died in 1897 at the age of 95 years. The collection consists of more than five thousand volumes of works on geography, history, ethnography, anthropology, etc. It was assigned by M. Vivien de Saint-Martin during his lifetime in trust to his publishers, Messrs. Hachette & Cie., for a yearly income of 6,000 francs, which was paid to him for twenty-three years.

The library is to be sold, if possible, as a whole, and the price asked for it is 21,000 francs. A catalogue will soon be issued.

BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXV **1903.** **No. 5**

TWO YEARS IN ARGENTINE AS THE CONSULTING ENGINEER OF NATIONAL PUBLIC WORKS.

A LECTURE BY

ELMER L. CORTHELL,
Dr. Sc., Civil Engineer.

Mr. Chairman, Ladies and Gentlemen :

In 1899 the Argentine Government, having conceived an extensive project of river and harbor improvement, and made the preliminary surveys, requested the U. S. Government to recommend an engineer who would come to Argentine and assist the Government by his advice in forming and executing the plans.

I had the honor of being selected for this position. After carrying out a two years' contract with that Government, I have returned to my own country with some knowledge of the conditions and some experience in meeting them which form the basis of this lecture.

At the final general session of the International Navigation Congress at Düsseldorf, July 4th, this last year, when called upon to respond for the Argentine Republic, I used the following words:

It may not be out of place to make a few comparisons between the two countries which by a singular coincidence I have the honor to represent—one as a delegate to this Congress, the other as a member of the Permanent International Commission. One of these countries is the Argentine Republic and the other the United States of North America.

Both are cosmopolitan, both have been populated largely from Europe; both had the task of supplanting savagery by civilization. The red races in each case had to give way to the Caucasian, or be assimilated with it. Both have great plains and immense river systems. The greatest river valley of the one is almost exactly equal to that of the other. Similar causes have produced nearly similar hydraulic conditions in each case. Both countries have temperate climates, both great mountain ranges; both some extent of arid lands and running waters for irrigation; both immense

areas of rich soils, made so by similar beneficent causes; both have excellent pasture lands and millions of cattle, sheep, and horses. In their cereals they are competitors with each other in the food markets of Europe—one is great and ambitious, the other smaller but earnestly devoted to progress and ambitious to fulfill its high destiny among the nations of the earth.

I shall compare Argentine with the United States in respect to some of its more important features, and you will see that the two great countries have much in common.

You must, if possible, imagine yourselves in a situation exactly opposite from yours in the United States in regard to the sun and the poles of the earth; you must look north for warm winds and south for cold ones. Your winter will begin in June and your summer in December. The north side of your house will be sunny and the south side in the shade. As you travel north from Buenos Aires, the capital, it will grow warmer; as you go south you will at last reach the glaciers. Your north star will be changed to the Southern Cross, and in all these changes you will at first be lost. You must also locate yourself geographically, and recollect that the northern line of Argentine is in about the same latitude south of the equator as Havana is north of it, and that the southern limit of Argentine corresponds to Labrador and Kamchatka; and that Buenos Aires, Capetown, and Melbourne are all in about the same latitude. Also that there are east and west differences. Buenos Aires is in about the same longitude as Cape Breton Island, east of Nova Scotia, and the circle of longitude along the most westerly boundary of Argentine nearly passes through New York City; and the course from the entrance of the River Plate to Liverpool is nearly a straight line. In order that the location of Argentine in reference to other South American countries may be appreciated, it should be stated that Buenos Aires is as far south of, say, Caracas, the present centre of revolutionary and unstable South America, as the north end of Lake Winnipeg, in Manitoba, is north of Caracas, or as far as the northern part of Greenland is north of New Orleans.

With this orientation of ourselves on the Western Hemisphere, and with these remarkable differences in position, let me call your attention to a very remarkable similarity.

In a paper read before the American Association for the Advancement of Science, at Buffalo, Aug. 5, 1896, upon the delta of the Mississippi, I described the ancient conditions of that great river in substance as follows:

First, a deep shore-line of the Gulf of Mexico when the site of Galveston was far out in the waters and the coast was 100 miles

inland from the site of New Orleans; a wide and deep estuary, 1,000 miles long, reaching into the heart of the continent to between St. Louis and Cairo, where, at Cape Girardeau, it met the ridge of the Ozark Mountains, stretching across the valley and holding back the ancient Great Lake, which covered Chicago 200 feet deep, and spread over all the great prairie States, and received and distributed over its bed the immense sediments of the Missouri and other great rivers in the north. Then came the cyclic change, lifting Florida out of the water and turning continental drainage north, cutting its way through the alluvion to Hudson's Bay. Then the breaking down of the Ozark barrier; the draining of the submerged area; the subsequent filling of the estuary and the advance of alluvial lands into the Gulf to their present line, 110 miles beyond New Orleans—a great and wonderful beneficence for the use and convenience of man by the Great Architect of the universe.

Had not my engineering experience upon the Mississippi River and its delta drawn my attention to this extremely interesting ancient history of the great river of North America, I might not have been so deeply impressed by its remarkable similarity with that of the Paraná River in South America; and for both histories I am indebted to engineering investigators—Gen. Warren in the first instance, and Col. Geo. Earl Church, an American engineer living in London, in the second instance, the latter probably better acquainted by personal contact with the geography and hydraulics of South America than any living man.

I am indebted to him and the Royal Geographical Society, of which he is a Director and a Vice-President, for most of what follows in relation to this ancient history of the great rivers of Argentine and Central South America.

There are four great breaks in the mountain-fringed continent, and these we call its great commercial doorways. The Orinoco, the Amazon, the La Plata, and the deep indentation of Bahia Blanca—one in Venezuela, one in Brazil, and two in Argentine. The three river basins occupy two-thirds of the entire area of South America.

The two with which we are most interested in this lecture are the La Plata and the Amazon, which have areas respectively of about 1,200,000 square miles and 2,722,000. But if we deduct from the latter the valley of the Tocantins, which has no direct connection with it, the valley of the Amazon is 2,368,000 square miles; its principal branch, the Madeira, has a volume of discharge nearly equal to the Amazon itself, and at the falls, which I shall refer to

later, it carries annually a volume equal to that of the La Plata, which has a minimum flow of about 534,000 cubic feet per second, and a maximum of over 2,000,000—a river 80 per cent. larger than the Mississippi, the Father of Waters, if we compare their mean annual discharges, the former being about 288 cubic miles and the latter 156 cubic miles. The Paraná ("the mother of the sea" in the Indian language), the principal affluent of the La Plata, is itself 46% larger than the Mississippi, its mean annual discharge being about 230 cubic miles.

What a river the La Plata must have been in ancient times, when it had a maximum discharge of 4,000,000 cubic feet per second, well up towards the modern Amazon, estimated to be 5,297,000, and greater than the ancient Amazon!

I have described the ancient conditions of the Mississippi—the Gulf of Mexico as a great estuary, and a deep shore-line extending well into the heart of the North American continent. The same conditions existed in the contour line of South America in the La Plata estuary. It extended 1,400 miles into the continent, and was 400 miles wide—eleven times greater than the Empire State. It was the great Pampean Sea, receiving the drainage not only of the present Paraná and its tributaries, but of the great Madeira River, with its immense discharge of waters and sedimentary matters—the source of great alluvial formations, discharging into a sea two-thirds the size of the Mediterranean.

When, in the processes of nature, the great underwater plains of rich soil had been formed during the comparatively short period of less than 100,000 years, a dam was thrown across the Madeira by the rivers Grande and Parapití coming down from the Andes, and a deposit more than 170 feet deep occurred forming this dam, which produced the ancient Lake Mojos, with an area of about 115,000 square miles—larger than that of the Great Lakes of North America combined, which is less than 94,000.

The remarkable action of these rivers, and the changes caused by it, are graphically told by Col. Church in his paper upon *Argentine Geography and the ancient Pampean Sea.*

The Grande and the Parapití entered the plain with a northern trend to contest with the great river of the north the possession of the gap. They struck it almost at a right angle, and slowly pushed their rival eastward over against the Chaco base of the Chiquitos sierras. Here the final conflict must have taken place, as the Grande and Parapití threw their dam across the outlet of the Mojos River, thus cutting off its exit into the ancient sea. No doubt the giant stream waged fierce war for thousands of years to keep its channel open, alternately sweeping away the barrier, and again yielding to the ceaseless volume of sand and clay which, visible to-day, con-

firms the victory of the Grande and Parapití. The dam, having finally become permanent, the formation of the ancient Lake Mojos was assured. When it reached the level of the lip of Guajará-mirim, its waters commenced to tumble over it, and carved their way to the Amazon. Since then huge volumes of alluvium have poured down the northern slopes of the Bolivian Andes; the ancient lake is now almost loaded with material, but it is not yet entirely obliterated. The muddy silt which covers the surface of the basin is so fine that, when an Indian goes up stream to the mountains, his friends ask him to bring back a stone that they may see what it is like.

Since forming the dam the Rio Grande has slowly been returning westward down the counter-slope which its own alluvium creates.

During the process we have described the Ancient Lake and tha Pampean Sea were connected, and their relation was similar to that of the Black Sea and the Mediterranean. Traces of it are still observable—notably the great, low, flooded morass of Xarayas on the upper Paraguay River, and the ancient delta of the Paraná, including the Ybará lagoon. The Salina Grande was also an arm of it—a great inland fiord. The sea, moreover, must have covered large areas of Paraguay, Corrientes, Entre Rios, and Uruguay, and, before the uplifting of the country, it extended southwest to the Rivers Chadi-Leofu and the Colorado, lapping round the southern slope of the Ventana range until the curved rim, concave to the northeast, which connects this with the Sierra de Cordova, was sufficiently elevated to cut off completely its southwestern extension.

This range was high enough to lodge the glacial rocks coming from the Andes, one of which, at Tandil, is so poised and delicately balanced that the hand can rock it, but it cannot be dislodged. This range, later, prevented the entrance of the destructive sea, protecting the great area from its waves.

Then came another factor into the beneficent problem of the Creator. Instead of draining the waters from the great deposits under the Pampean Sea, as He did in North America, He lifted the Andes higher, and with them their Atlantic slopes, until the latter were ultimately lifted to their present level, forming the "Plains of the Pampas," the soil of which is 50 feet deep, and of surpassing richness—an area of 600,000 square miles, one-fifth the size of the United States and five times that of Great Britain. Thus, by cyclic changes in the Northern Hemisphere, and by fluvial and sedimentary action, and seismic changes in the Southern Hemisphere, have been formed the great interior agricultural regions of the United States and Argentina.

Let me now quote from Mr. Revy's work on *Hydraulics of Great Rivers* (Argentine rivers which he surveyed), where he compares the rivers as we now find them with others well known:

Great as the volume of the Paraná River at its lowest summer level is, immense

in comparison to the largest European river, and much larger than that of all the European rivers put together, it is but a small fraction of its flood volume during exceptional rises; and we can only wonder at the magnitude of the sources which for months—nay, for whole years together—pour forth inconceivable masses of sweet water, every drop of which had been raised by the power of the sun from the Pacific and Atlantic Oceans above the tops of the highest mountains of Brazil and the Andes.

To convey an idea of the magnitude of the rivers which have been considered and analyzed in the preceding chapters, we have shown on Plate V several of the larger-known rivers, such as the Danube and Thames of Europe, and the Mississippi of North America. They are all drawn to the same scale, and their relative size may somewhat be appreciated. The Mississippi is not unlike the Uruguay in dimensions and other features. We have similarity in width, depth, currents and fall, although the North American is the larger of the two. Comparing, however, the Paraná with the Mississippi, the former might claim the latter as his eccentric daughter under fourteen. The low-water dimensions measure a river's greatness, although things of different natures and character do not bear strict comparison. What we, however, understand by greatness is possessed in an exceptional degree by the Paraná.

In order further to compare the Paraná River with others, it may be stated that its annual flow is double that of the Ganges, three times that of the Saint Lawrence, four times that of the Danube, and five times that of the Nile. We have records of 608 cubic miles in one year.

There are differing conditions of importance between the Paraná and the Mississippi, explaining the causes of the greater discharge of the Paraná. While they both flow south, one flows from colder to warmer and the other from warmer to colder regions; and it is in the warmer regions in both cases that the rainfall is the greater. On the Mississippi, in the northern regions, where we find the greatest drainage area, the rainfall is about 35 inches per annum; in the southern, where the area is less, the rainfall is 60 inches per annum. With the Paraná there is a rainfall of about 60 inches in the northern part, where the drainage area is greater, and about 40 inches in the southern part, where it is less.

The length of the Paraná River is about 3,000 miles; its navigable length, between Cuyabá in the north and the mouth of the Paraná in the delta of the La Plata, is 1,825 miles. The Uruguay River, from San Javier to the delta of the La Plata, has a navigable length of 603 miles. The Paraná River is made up of the two important rivers which unite at the City of Corrientes—the Paraguay and the Alto Paraná. The length of the latter above Corrientes to the falls of the Yguazú is 365 miles, and it is navigable nearly to that point. These wondrous falls excel in beauty, as well as exceed in dimensions, the Niagara Falls.

The latter are 160 feet high, as a maximum, and four-fifths of a

mile long, including Goat Island. The Yguazú are 213 feet high in one leap and 106 feet in two leaps, and 2⅓ miles long, with at times an immense volume of water.

The gorgeous and varicolored foliage of the luxuriant subtropical vegetation, which abounds on all sides, adds a charm to the falls. They rank among the most beautiful and wonderful works of the Creator.

The remolinos, or whirlpools, below the falls equal the famous whirlpool at Niagara.

The Uruguay is an entirely different river in every respect from the Paraná. It is at times a mighty river, rivalling the Paraná; at others it sinks into comparative insignificance. The Paraná is a great river at all times.

The Paraná is a type of a truly great river; the Uruguay represents a mighty torrent of extraordinary dimensions.

The Uruguay rises near the Atlantic seaboard in Brazil, in the Serra do Mar, then runs west to the highland of the territory of Misiones. These highlands prevent it from uniting with the Alto Paraná River at that point, which is only about 68 miles distant. Along 600 miles of its course, from San Javier to Concordia, the bed of the river is filled with rocky ridges, which, at low water, prevent continuous navigation; but during the floods, which are quite sudden, but not long-continued, the river is everywhere navigable. The river rises, in floods, at Concordia about 46 feet. Compared with the Paraná, it is a clear stream, carrying very little sediment in suspension. The Paraná is an entirely different river. Its source being in the tropical and rainy region of Brazil, on the flanks of the Andes, its floods are much longer-continued. At the confluence of the Paraná and the Alto Paraná at Corrientes the rise of the floods is about 33 feet; at Rosario, 225 miles above Buenos Aires, it is from 19.7 to 23 feet, or 23½ feet in extreme floods. When these occur the river is about 23 miles wide, covering the entire country to a depth of from 6 to 10 feet, and extending to the highlands of the Province of Entre Rios.

The physical characteristics of the bed of the river are, consequently, entirely different from those of the Uruguay; the bed of the latter is stable, that of the former very unstable. The sedimentary matters carried in suspension, however, are very much less than those of the Mississippi—probably only one-tenth of the amount carried in the Mississippi in times of flood. For this reason the changes in the bed and banks are less radical; the most noticeable change is the movement of the island and bars down stream. For

example, the Island of Espinillo, in front of the City of Rosario, lying in the middle of the river and about 2½ miles long, has moved, flanking down stream about 2½ miles in the last 50 years, and by this movement the advancing bar of the island has approached the river bank in front of Rosario and closed up the navigation channel.

The maximum velocity in great floods often reaches 6½ feet per second, although usually it is much less—equal to that of the lower Mississippi.

Both rivers are susceptible of improvement by dredging, the Páraná to Asunción, which is 842 miles above the mouth, and the Uruguay to Concordia, which is 230 miles above its mouth. In the Paraná there is nothing but sand to be removed throughout its entire length; in the Uruguay there are several places where it is necessary to remove rock and gravel. But, generally, the channel can be deepened by hydraulic or suction dredging.

The National Government is under obligation, by the law passed by Congress for building the Port of Rosario, to make and maintain a depth of 21 feet at low water in the Paraná River from the head of the delta to Rosario, and in the delta of the La Plata to Buenos Aires a depth of 19 feet at low water, which is about 21 feet at mean high tide. It has been proposed to make and maintain a channel of the following dimensions: From the mouth of the two rivers, at the Island of Martin Garcia, at the head of the La Plata estuary, to Rosario, a depth of 21 feet and a width of 328 feet; Rosario to Santa Fé, 292 miles above Martin Garcia, 19 feet deep and 328 feet wide; Santa Fé to Corrientes, 10 feet deep, and the same depth to Asunción. Santa Fé, or its seaport, Colastiné, is the head of ocean navigation; above that point it is river navigation by steamboats.

On the Uruguay River it is proposed to make a channel 19 feet deep and 328 feet wide, from Martin Garcia to Concepción del Uruguay, 137 miles above Martin Garcia, and thence 15 feet deep to Colon, and 9 feet deep and 8 feet over the rock to Concordia, which is 230 miles above Martin Garcia.

The low-water plane, or zero, in both rivers is that of extraordinary low water, so that, generally, the low water does not reach this plane within about half a metre to one metre. Consequently, there can generally be depended upon from 2 to 3 feet more water than I have stated. Between Rosario and Buenos Aires there is now no bar over which there is not 21 feet of water at zero, although two bars need to be dredged and buoyed in order to make a straightened channel. This the Government is prepared to do.

As to the Port of Rosario a contract has recently been made, under the law of Congress, to make a modern seaport at this point, with all the latest and best facilities for handling cargo. The commerce at Rosario is at present 1½ million tons per annum. It is a very important exporting point for cereals, and when the port is completed according to the plans adopted it is expected to be a great importing port as well. There are ports below Rosario, such as Villa Constitución, San Nicolas, and San Pedro, and above Rosario, Diamante, Santa Fé, Colastiné, and Paraná. On the Uruguay River, Concordia, at the head of the steamboat navigation, is an importing and exporting port for that section of the country. Its registered tonnage is about half a million tons, and the actual weight tonnage about 100,000.

The country between the Paraná and Uruguay rivers is practically isolated from the rest of the country, and its situation is very similar to the country lying between the Euphrates and the Tigris; for that reason it has been called the *Mesopotamia Argentina.*

There are at present in this area three railroad systems—the Argentine North Eastern, which runs from Corrientes, on the Paraná, to Monte Caseros, on the Uruguay, and from there to Santo Tomé, on the same river; the Argentine Eastern from Monte Caseros to Concordia, and the Entre Rios railroads, the main line of which connects Paraná and Concepción del Uruguay, with branches to Victoria, Gualeguay, Gualeguaychú, and Villaguay. Within a few months a connecting line will be completed to Concordia, forming a link between the Argentine Eastern and the Entre Rios systems. It has been proposed to unite these three systems and to extend the Argentine North Eastern from Santo Tomé to Posadas on the Alto Paraná, passing through the colonies which the Government is establishing in that territory. Posadas is its capital. The Central Paraguay Railroad, which runs in a southeasterly direction from Asunción, it is proposed to extend to Villa Encarnación, a small town on the opposite side of the river from Posadas; to change the gauge, which is 5½ feet, to the normal gauge of the other three railroads, which is 4 feet 8½ inches; make a transfer by car float at Pasadas; extend the Entre Rios railroads to a port of deep water, either on the Paraná or Uruguay, and do a "through" business between Asunción and this new seaport, which will be only a few hours distant from Buenos Aires.

With the Paraná River improved to Asunción, and the Uruguay improved to Concordia, with the railway systems united and ex-

tended to a good seaport, this great interior district of the country will have an ideal system of transportation, and the shipper may take his choice, to ship by rail or by water, thus establishing a very useful and reasonable competition between water and railway, to the great advantage of the people.

In reference to the Rio de la Plata itself, it is an immense shoal estuary. It is the depositing-ground of the great Paraná River. This estuary, in a not very remote period, extended above Santa Fé; this is shown by the comparison of old maps, of which 92 have been collected and copied and placed in the library of the Ministry of Public Works. These maps date from the year 1529 to 1885. Even in this comparatively short period remarkable changes are shown in the delta of the Paraná, which is now a true delta, almost exactly in the form of the Greek letter Δ. It is 40 miles across its face; it slowly extends itself in the head of the estuary, and through the delta nearly a dozen outlets of the Paraná River find their way. It is very much like the deltas of the Danube, Ganges, and Mississippi.

The superficial extension of the Rio de la Plata exceeds 18,000 square miles; it is about 186 miles long, and varies in width from 186 miles at the ocean, between Capes San Antonio and Santa Maria, to 1.12 miles at the extreme point of the head of the estuary, at Punta Gorda.

To understand the physical conditions of the estuary, it is necessary to divide the Rio de la Plata into Superior and Inferior, or upper and lower. The Rio de la Plata Superior lies above a line extending between La Plata and Colonia; the Inferior below that line to the sea. Over a distance of about 25 to 30 miles between Martin Garcia and the anchorage of Buenos Aires there is a normal depth through the best channels of from 16 to 20 feet at low water.

The National Government has recently completed the dredging over the San Pedro bar lying in this region, increasing the depth of 18½ feet to 21 feet where there was formerly only 15 feet. In the Canal de las Limetas, or Nuevo Canal, by natural forces and by the constant movement of steamers, there has been obtained a depth of about 19½ feet, or 21½ feet at mean high tide. Opposite Farallon, a rocky point on the Uruguay shore and opposite Buenos Aires, there is, along the course of navigation, about 19½ feet at low water. The Government has buoyed with luminous buoys the entire route from Buenos Aires to the mouths of the Paraná River, the Bravo, and the Guazú, and has placed a floating

semaphore below Martin Garcia for the benefit of navigation, recording constantly by signals by day and by night the depth of water in the channel. It is now proposing to connect this semaphore by a telephone cable with the telegraph cable of Martin Garcia, so that communication may be established between the ships lying at anchor (waiting for the tide, or passing near the semaphore) and the offices of the agents at Buenos Aires or Monte Video.

A careful study of the different conditions in the delta of the La Plata shows that the only method of improvement in such a vast expanse of water is by dredging and buoying the best channels.

In the lower Rio de la Plata there are very serious conditions. A bar on which there is a least depth of 20 feet at low tide lies between the anchorage of Buenos Aires and Monte Video; the material in this bar is very soft, and vessels plough their way through it on ordinary tides; but the great extent of the bar is the serious condition. Between the 24-feet curves, straight through this bar, there is a distance of 24 sea miles. To make a channel by dredging would require the removal of probably 10½ to 13 million cubic yards; and it is very doubtful if, on such broad extension of water and in such soft material, a channel could be maintained. But it is hoped that the plan now proposed of anchoring five lightships in the line of navigation and in the direction of the current, and which can be seen from each other, will have an effect upon the bar by the continued movement of deep steamers through it. The examination of the Rio de la Plata Inferior has been intrusted by the Government to the Ministry of Marine, which is making very extensive surveys and examinations over the entire area.

The estuary at this point is 46 miles wide, and five high towers on shore and others anchored within the area to be surveyed are necessary in order to cover this great Punto Indio bank.

These are the general physical conditions of the Rio de la Plata and its great tributaries.

The very important project of making a deeper channel of access to the Port of Buenos Aires and enlarging the port, to give it not only a greater area and more facilities, but greater depth in the enlarged part, is now before the Government, and the plans for it —made by myself—have been approved. There are alternative projects to meet the commercial necessities of the country: one is to deepen the present Port of La Plata, and endow it with more facilities, where vessels drawing 24 or 25 feet may come in and go

out at any stage of the tide; or to build a deep-water port, with a depth of not less than 30 feet, on the seaboard outside of the difficult conditions of the Rio de la Plata. A concession has been granted, and the project submitted to the National Government, for an artificial port in the great bay of Samborombon, which is nearly opposite Monte Video; and another concession for a port at Mar Chiquita, near Mar del Plata, on the ocean, has also been granted.

In addition to the great drainage basin of the La Plata, there are further south the large rivers Rio Negro and Colorado, which combined have a drainage area of 464,000 square miles. The channels are not susceptible of improvement for a large commerce; but they will in the future furnish water for an extensive irrigation and steamboat navigation.

The hydraulic conditions are great; but the mountains are greater, and have exerted a powerful influence on the continent, not only its climate and its running waters, but upon mankind. On these lofty table lands lived the Incas and flourished their great empires. Among the clouds have fought for supremacy the Incas troops and the Spanish soldiers. And here, too, have the struggles for liberty taken place; here Bolívar and San Martín led their troops to victory and continental freedom from the domination of Spain.

An orographic map of South America will show what immense areas are given up to mountain ranges and lofty summits. In their widest part the Andes are 500 miles in breadth. Some mighty force seems to have pushed them and the entire continental line eastward, and massed the ranges into a complex system of mountains, towering isolated peaks, and parallel, transverse, and interlaced ridges without number. In Bolivia, not far north of the country we are describing, there are thirty-two peaks above 17,000 feet high, some of them reaching over 21,000 feet; and in Argentine is the lofty Aconcagua, lifting its solitary crown to an elevation of 23,080 feet, rivalling the loftiest mountains of the world. And Famatina, in the Argentine Province of Rioja, rises to 20,680 feet, and the grand mountain Tubungato is 22,015 feet high.

Between Argentine and Chile, between latitude 23° and 35°, the mountain passes, which are from 10,000 to 14,000 feet high, are blocked with snow from May to August, and they are swept by violent storms.

The height of the passes, all the way from 7° to 37° south lat., Northern Peru to Southern Argentine, shows the determination of

nature to oppose transit by man, piling up in his pathway these almost insurmountable obstacles. When it is considered that this immense barrier covers a sixth part of the circumference of the globe its influence upon the development of the continent is apparent. The general condition, as far as civilization is concerned and the obstacles in the way of mankind, are forcibly and most interestingly described by Col. Church, comparing them with the conditions in North America:

The contrast between North and South America is remarkable. Nature was in her kindest mood when she created the former—gave it vast and fertile plains; low and readily transitable mountain ranges; extensive systems of navigable lakes and rivers, the latter not too difficult to bridge; great forests of the most useful timber immense mineral wealth, including an abundance of coal and iron; a coast-line offering numerous excellent harbours easily accessible from the interior, and a temperate, inviting climate over almost its whole area. It is a land where man seems to live with nature on friendly terms, and where the wave of humanity, as it rolls westward, encounters no obstacle which it cannot readily overcome.

How opposite to all this is South America! It lies mostly within the tropics; its fertile plains, except those of the Argentine Republic, are difficult of access; it is a formidable task to scale and cross its mountain ranges; its rivers, with rare exceptions, are of violent flow and full of obstacles to navigation, and its largest ones not within the limit of practical engineering to bridge; its vast forests are hard to work and frequently impenetrable; its mineral wealth, immense in nobler metals, includes but little coal and iron; its coast has but few good harbours, and these are almost all mountain-locked; its climate, although in many parts delightful, is uninviting over extensive regions; the forces of nature are so vigorous that man can seldom count upon the unqualified control of them, and, in general, they confer generous reward only upon well-applied and persistent energy.

The above is an introduction to his very important paper read before the Royal Geographical Society, Feb. 25, 1901, entitled "South America: An Outline of its Physical Geography," a paper of 74 printed pages. His conclusions are as follows:

My analysis shows that, in general, man finds himself confronted by severe conditions in his struggle with nature in South America. Thus far, however, his efforts to develop and utilize its vast resources have made its commercial history an epic. The thought naturally presents itself that had North America fallen to the lot of the Latin race in the European occupation of the New World, and South America to the Anglo-Saxon, the former might still have maintained its old supremacy; for the more rapid progress of the latter may not be due so much to racial superiority as to advantageous geographical surroundings.

Argentine is a country one-third the size of the United States; a climate salubrious and comfortable; of immense plains formed by nature, as I have already shown, for the use of man—plains where the railroads find no natural obstacles worth mentioning in the way of their good alignment and construction; where we have, I think, the longest railroad tangent in the world (186 miles), between Junin

and La Cautiva, on the Pacific Railroad; plains covered with the cattle of the great estancias, thousands of them of the best breeds in one estancia, and sheep by the millions, and great fields of wheat, corn and linseed, the principal agricultural products of the country. An "estancia" might be called a "ranch" on the great plains of our Western States. Their size varies from about three thousand acres to seven hundred thousand acres; probably twenty-five thousand acres might be considered an average size.

As might be expected, the business of cattle-raising requires expert men similar to our cowboys; they are called "gauchos." They are fearless riders and masters of their trade. The horses they ride are generally rather undersized, but wiry and of great endurance. They are much like the best class of Mexican horses.

As the cattle roam over great ranges, which are unfenced, it is necessary to brand them, as we also do on our great plains.

The homes of the gauchos on the estancias are not elegant, to say the least, but in the comparatively mild climate of Argentine they do not need as much protection from the weather as in many of our cattle districts of the Far West. They are a contented people, and while they do not have the facilities for entertainment which a city population has, they nevertheless have their own fun on feast days and whenever their arduous and roaming life will permit.

As might be expected of a country stretching through so many degrees of latitude and rising from the level of the sea to the highest Andes, there is a great variety of climate and generally an abundant rainfall. Buenos Aires is on the same parallel south of the equator as Wilmington, North Carolina, is north of it. Snow is almost unknown, and scarcely ever is ice or frost seen. The climate in the summer is tempered with the great body of water of the River Plate.

The rainfall of Buenos Aires averages 35½ inches per annum—about equal to that of the Northern States of the United States. At Asunción, Paraguay, it is 53 inches—about equal to that of New Orleans. The temperature is remarkably uniform. The mean temperature in June and July, 1899, the coldest months, was 54° (F.), and in January and February, the hottest, 76°; the annual mean being 62°. In twenty years the mean was 63°; summer, 77°; autumn, 65°; winter, 54°, and spring, 63°; mean of January, the warmest month, 79°; of July, the coldest, 52°. The extreme, or extraordinary, limits were 107°, and very rare 104°, frequently 95°, and in winter 23°, which occurred but three or four times. In February, 1900, the heat rose to 103°, but the period of intense heat was only eight days. Such conditions are extremely rare.

The agricultural, industrial, and commercial features are those of greatest interest, and yet to give an adequate idea of them we must take figures.

The population of the whole country is now about 5,000,000; its present rate of growth per decade is about 40 per cent. The United States is 20 per cent., Germany 16 per cent.

The Province or State of Buenos Aires is as large as Illinois, Indiana, Maryland, Connecticut and Massachusetts combined, or two and one-half times as large as New York State—120,000 square miles, and mostly plains, with 750 miles of coast-line. It has 1,200,000 inhabitants, 10,000,000 head of cattle, 80,000,000 sheep, and 2,200,000 horses. In 1901 it raised 762,000 tons of wheat and 1,360,271 tons of corn—a respectable showing; and the value of agricultural and pastoral products was $740,000,000. The wheat area of the Republic, mostly in four provinces—Buenos Aires, Santa Fé, Cordoba, and Entre Rios—is about 8,500,000 acres, and 80,000,000 to 100,000,000 bushels of wheat are exported. The total area under cultivation in the Republic in 1901 was 17,500,000 acres. The increase over 1891 was 136 per cent. The crops were: Wheat, 1,964,000 tons; linseed, 490,000 tons; corn, 2,134,000 tons. The total of arable land is 253,000,000 acres, of which 240,000,000 do not need irrigation.

In the whole Republic there are over 30,000,000 head of cattle. The annual increase is 25 per cent. There are 5,600,000 horses and 120,000,000 sheep (in the United States there are 62,000,000). The annual increase in Argentine is 33 per cent., and 3,000,000 carcasses were sent to Europe in 1901.

One of the important industries of the country is the "saladeros," which from its name signifies salted or jerked beef and extract of beef, etc. Nearly $40,000,000 are invested in them. Brazil is the principal market. Over 1,000,000 head of cattle were killed for the saladeros in 1900. The meat-freezing factories exported 100,000 tons of meat in 1901. An important factor in the Argentine meat trade—and, it may be said, in the meat trade of the world—is the successful result of continued efforts to send chilled meat to Great Britain. The River Plate Fresh Meat Company started this trade in 1901, exporting in that year 29,919 quarters of beef; and from January 1st to May 31, 1902, five months, it exported 38,148 quarters. Since that date the imports into Great Britain have rapidly increased, and recent dispatches from London relate how this factor in the London meat market is alarming the Beef Trust of the United States and the Australian shippers. Argentine is placing its chilled

meat in London at a considerably lower price, and is competing successfully with meat from the United States.

As might be expected, the wool industry is very important, about one-half million bales shipped to Europe, being the export product in the year 1901–1902—31,000 to United States and 28,000 to Great Britain.

Argentine is a protectionist country, and its resources for conducting the Government are largely raised from the Custom dues. In 1899 the imports free of duty amounted to $14,769,933 (gold), and those subject to duty $102,080,738 (gold). The exports were $184,917,531 (gold). The United States imports 300 millions per annum of sugar, hides, linseed, jute, hemp, wood, and fruit, and 36 million of wool and woollen articles. All of these are produced by Argentine; yet only 6 millions of the 336 millions come from Argentine, or two per cent.

The United States exports, including cereals, meat, and live stock, are about 920 millions, and only 10 millions of this go to Argentine, or about one per cent.; while Argentine's purchases of the same articles in England were 39 millions, and 60 millions from other countries.

A volume would be required to take up the subject of the savage tribes alone of America—450 principal groups, and 2,000 if we separate them by dialects. And another volume would be needed to treat of the civilized aborigines of the table lands of Mexico and Peru; of the Toltecs and Aztecs and of Quetzalcoatl and the Incas—the pontifices who ruled over a vast population covering 40 degrees of latitude of South America from Northern Argentine to the Antilles. The barbarism of the savage and the civilization of the races of the table lands have nearly disappeared. You would have no better knowledge of that vast horde of wandering tribes that infested the great plains of the Pampas if I should mention their names. Some few still exist; the census gives less than 20,000 as the total of Indians still existing in Argentine. Once numerous and brave, only about a dozen remain of the Paraquas—the descendants of the Aguas—and of the Tobas and Chinipis, who later occupied their country, a remnant only exists.

It may not be generally known that, from the first arrival of the Spanish adventurers to the successful end of the great struggle for liberty in South America, there was always dissatisfaction, unrest, and hatred of the conquering race. The seeds were sown in bloodshed, in the persecution by the Inquisition, and in false commercial and governing methods of Spain and Portugal, the mother coun-

tries. The difference between North and South America in this respect was very great.

The symptoms of resistance against Spanish domination showed themselves in the dawn of the history of South America. Frequently the Indian tribes attempted to throw off the yoke of some more than usually severe and cruel oppressor. In the early days of the 18th century the revolution of Tupac-Amaru was really a war of races rather than a political revolution, as it had for its principal purpose the extermination of the Spanish. In Venezuela in 1711 this same hatred showed itself in the proclamation of a mulatto as King of the Mestizos. Half a century later the seed sown by Antequera bore fruit in New Granada.

We may say that the struggle and the preparation of the ground for civil and religious liberty began earlier in South America than in North America. In the British Colonies there was no strong sentiment against foreign rule until the imposition of the taxes required to furnish George the Third with revenue to pay off his debt of 148 million pounds sterling. Even Washington, in July, 1775, when he took command of the Continental army, declared that the idea of independence was repugnant to him. Only later did events hasten and make inevitable the separation from the mother country.

It would be a subject of great interest to enter upon—the three great leaders and heroes of American revolutions—

WASHINGTON—BOLÍVAR—SAN MARTÍN,

a triumvirate of liberators.

Of the two former you already know much, possibly, also, of the last; but you may not know that it was by his patriotism and generalship that the whole of southern South America was freed from the yoke of Spain—Argentine, Chile, Peru, and Bolivia. His biography is a romance of most absorbing interest.

Born in 1778, in Argentine, in Japeyú, his early education was in Buenos Aires, completed in Spain. He served with distinction and great bravery in the wars of Spain. Early he was imbued with the doctrine of liberty for his native country; spent a year in Great Britain in 1811 forming associations and a secret league devoted to the liberation of Argentine. Landed in Buenos Aires in 1812; soon in command of a regiment of grenadiers; selected soldier by soldier, officer by officer, imposed the most rigid discipline. Placed in command of the army to reorganize it, he marched to Mendoza, the nearest point to the Andes; and, imbued with the idea that no

liberty would be secure for his country until the Spanish armies were beaten and expelled from Chile, Peru, and Bolivia and the whole of South America, he formed his plans for an invasion of Chile. He was the very incarnation of determined patriotism; nothing, not even revolutions and discord behind him in his own country, could deter him from his great work. At this moment Napoleon fell, and Spain prepared an expedition of 15,000 men destined for the Rio de la Plata. In Chile and Peru the Royalists were victorious; but in Argentine on the 9th day of July, 1816, at Tucuman, the declaration of independence was proclaimed, which, like our own, is sacred in the heart of every Argentine.

In the midst of these great and momentous events, San Martín recruited and drilled and clothed and provisioned his little army destined to conquer a continent, to scale high mountain passes, and pour down upon an enemy largely outnumbering his own. His plans were known only to himself, and when asked by those high in authority what they were, he refused to tell, and said no one should know them; and should his pillow get an idea of his plans, he would cast it into the fire. He ostensibly made roads over certain passes, and, when all was ready, led his army over another and very different pass and came down upon his foe and defeated him in Chacabuco; and again on the plains of Maipú, routing the enemy completely and assuring the independence of Chile. Then, though anarchy was reigning in Argentine and his Government was calling upon him to return, his fixed and irresistible purpose of dealing the final blow to Spanish authority in Peru pushed him forward. With a fleet commanded by Lord Cochrane, and with English and U. S. officers in command of the ships, he sailed from Valparaiso with his troops up the coast in December, 1818. He had only 4,430 men, Argentines and Chileans. The Viceroy of Peru had 23,000 soldiers awaiting this little army. On July 28, 1821, as a result of his campaign, the independence of Peru was proclaimed in Lima and San Martín made dictator. In the meantime General Bolívar, after liberating Venezuela and Colombia, reached Quito, and his forces, united with an Argentine division, routed the Spanish army in the battle of Pichincha.

The two liberators had a conference July 26, 1822, the details of which were kept secret; but it is a well-known fact that San Martín comprehended that, in order to accomplish South American independence and avoid the scandal to the world of a break with Bolívar, caused by the latter's thirst for glory, it would be best for him to depart from a scene where his great presence had no place.

He resigned the dictatorship of Peru; passed to Chile, to Mendoza, to Buenos Aires, to Europe, where he resided four years in Brussels on a very modest pension. Once more, in 1829, he returned to La Plata; but learning that anarchy prevailed in his own country, and deaf to the entreaties of his friends to come to their help, he returned to Europe, saying "No; General San Martín will never spill the blood of his fellow-citizens; he will draw the sword only against the enemies of America." And, without even seeing Buenos Aires, he sailed for the last time to his voluntary exile, dying suddenly August 19, 1850. He was free from those theatrical qualities which appeal to the multitude. In this great character predominated those moral qualities which entitle San Martín to a prominent place in South American history. Inflexible in the discharge of duty, a rigid disciplinarian, everything was subordinated to the high mission to which he had devoted himself, and he never sacrificed his cause to ambitious or personal vain glory. He was the incarnation of an idea. His modesty, his pure and elevated character, the simplicity of his life and the nobility of his principles give him rightfully a position by the side of the great heroes of history.

Reciprocal trade would open the United States to Argentine wool and treble the production in a few years. There should be direct lines to that country from the United States, and the time should be reduced from about 27 days to 15 or 18 days. We should ship to Argentine our manufactures, our coal, pine wood, petroleum, etc., and we should receive from Argentine its wool, hides, grease, dried fruits, hard wood for tanning and dyeing, etc. Now, for want of return freights, steamers load at United States ports for Buenos Aires, and return via Liverpool to New York, frequently via South Africa.

In reference to wool, I have already stated that in the entire United States there are only about 62 million sheep; while there are 120 million in Argentine. It is a well-known fact that the ranges in the Far West of the United States, which are absolutely necessary for sheep-raising, are rapidly being reduced by the extension of our population westward and the cutting up of great areas into smaller farms. Not only do the smaller farmers as they go west wage constant war with the sheep herders, but the cattle-raisers do the same; so that the time is sure to come very soon when we will need the wool of Argentine. What this country should do with a great agricultural country like Argentine, capable of immense productions, is to receive its raw materials and ship to it our manufactured goods.

It is proper in closing this part of the subject to quote a short paragraph which appears in the Argentine Year Book, recently published, from the pen of Mr. Tidblom, Chief of the National Department of Agriculture and Live-Stock Industry. In closing a long article on the Agriculture of Argentine he makes the following statement:

Nature has undoubtedly endowed Argentina with advantages for agricultural and pastoral farming not to be found in any other country of the world; and it is not too bold a forecast to say that if the country continues to improve her natural gifts in the same degree in which they have been cared for and improved up to the present time the day will come when the Argentine farmers will have absolute control of the world's food markets.

The money of the country is on a paper basis, and the minimum value of a dollar was fixed in 1899 at 44 cents gold, or 127 per cent. premium. The market value of a gold dollar expressed in paper money varies now between $2.27 and $2.34, and the gold dollar of the United States is at a 4 per cent. premium over that of Argentine.

Railways have had an extensive development. In 1867 there were 355 miles; in 1880 there were 1563; in 1890, 5,862; in 1900, 10,601, of which 1,243 belong to the Government and 9,358 to foreign companies. In length of line Argentine stands ninth on the list of countries; but, as compared with the United States, the mileage is about 5 per cent. The paid-up capital is $550,000,000 (gold). The total receipts in 1900 were $40,000,000 (gold). The length of line per one thousand inhabitants is 3.46 kilometres; while it is 4.86 in the United States, 0.93 in Germany, and 1.70 in France.

The great Southern, the Western, and some other lines are still making extensions, and the Southern has crossed the Neuquen River, and is looking for a pass to cross the Andes.

There are three gauges—5 feet (which is really the standard), 4 feet 8½ inches, and a narrow gauge, usually about 3 feet 3 inches.

The total length of telegraph lines is 28,000 miles, of which 12,000 belong to the Government. In the United States the Western Union alone has 192,705 miles of poles and cables.

One of the most interesting railroad lines now in construction is the Transandine, which, upon leaving Mendoza, follows the Mendoza River to its source and climbs to the summit of the Pass of the Andes, 3,900 metres (13,000 feet) above sea-level. The Abt system of adhesion up to 2½ per cent., and then Rack to six per cent. is employed.

Some very interesting views can be had of the approach from the Argentine side. Lofty mountains, rugged slopes, rushing

rivers and the Puente del Inca (the Incas' bridge), a natural bridge formed evidently by the river breaking through a great deposit of cemented material, caused by an avalanche. The railroad is not completed, and some of the most difficult work is yet to be done.

Speaking generally of the railroads, they are well constructed, though good ballast on the great plains is lacking. The cars are like American cars, but the first-class day coaches are much more luxurious than ours. All the long-distance trains have comfortable sleepers; a buffet and dining car goes with all through trains.

In regard to the industries of the country, while the main products are agricultural and the export as well, important industries are slowly developing. While sugar is an agricultural product, the 40 sugar mills may be classed among the industries. In 1870 Argentine imported 22,000 tons, but in 1889 exported 58,000 tons. There are $52,000,000 invested.

There are over 60 breweries in the country. The annual product is about 4,400,000 gallons.

There are 182 distilleries; the alcohol is made principally from corn. The annual product is about 8,000,000 gallons.

Milling is a very important industry. The first steam flour mill was built in Buenos Aires in 1845. In 1895, by the census of that year, there were 659 mills—234 worked by steam and 303 by water; the total amount of flour made was 383,147 tons. The country now exports about 80,000 tons, all in bags and mostly to Brazil, valued at about $3,000,000 (gold). At present the Brazilian market is giving a preference to United States flour because it arrives in barrels, which must lead to the same method in Argentine, although the wood suitable for barrel staves is very limited.

The wine industry is one of the most important. The soil suitable for grapes covers an immense area, extending from the northern to the southern provinces along the slopes of the mountains. Mendoza and San Juan, west of Buenos Aires, are, however, the best adapted to vine-growing. In 1900 there were 89,000 acres in vines, valued at about $10,000,000 (gold). The transportation of the wine by rail in 1901, in Mendoza alone, amounted to 160,000 tons, and the stock of wine in the wine establishments (bodegas) was 33,000,000 litres (8,700,000 gallons).

The dairy industry a few years ago had practically no existence, and nothing at all was done with the milk of the millions of cows in the country. Now large dairies are springing up in all the pastoral parts of the country; the neatest and most tempting places to enter in the city of Buenos Aires are the white-painted, scrupu-

lously clean places for drinking milk, scattered all over the city, the milk being sent in from the great "estancias." These dairies are being built in the most approved style, and they prepare pasteurized, maternized, sterilized, and all other kinds of milk preparations. The exports of butter alone in 1901 were 3,322,391 pounds. In the year 1895 it was only 880,000 pounds.

Iron and steel industries are important, although there is practically no ore or coal in the country. In 1895 there were 154 iron foundries and 156 repair shops, with a capital of $15,000,000. Every class of machinery is now manufactured, even to small engines and boilers.

Matches: the tax alone in 1899 amounted to $2,000,000.

Tobacco: the excise tax on which and its products in 1901 amounted to $4,200,000 (gold).

Four million dollars (gold) are invested in textile manufactures employing 6,200 persons; canvas factories one million (gold) employing 2,000 persons and making 5,000,000 yards, and ten million dollars in hat factories employing 700 hands.

As to mining, there are valuable copper mines containing gold and silver, also rich veins of gold, with recent discoveries of iron ore; but these various products have not been developed to any great extent, due to remoteness from railroads and the roughness of the country, making the exportation very costly. The minerals include gold, borax, copper, marble, silver ore, lead ore, etc.

After these cursory statistics, it is a relief to turn to the beautiful and really great city—Buenos Ayres, and give you a brief outline of its most important characteristics.

Its early history is full of trouble. Founded in 1535, destroyed and rebuilt; and then from 1650, when there were 400 houses, it grew slowly under the old Spanish régime, and later, under dictators and bad rulers, it slowly advanced in spite of an unstable Government. In 1852, when the noted Rosas was turned out, it had 76,000 inhabitants. Chicago was just then passing through the hard trials of a little Western town, and had not more than 20,000 people. In 1864 Buenos Aires had 140,000 inhabitants, and Chicago about the same; in 1869, 178,000. But Chicago had already started on its phenomenal growth and reached over 300,000. In 1887 Buenos Aires had 400,000, and Chicago 1,000,000.

In September, 1902, Buenos Aires had 861,513, and it is growing at the rate of about 40 per cent. per decade. It is destined to reach the million mark by the year 1906. It is now the largest city in the world south of Philadelphia, if we except Chinese cities.

Comparing its present rate of growth per decade with some other cities, we find the following: Greater London, 20 per cent.; New York, 37 per cent.; Chicago, 54 per cent.; Philadelphia, 23 per cent.; Greater Berlin, 19 per cent.; Buenos Aires, 40 per cent.

The city is on the right bank of the River Plate, a sloping bank 50 or 60 feet above the level of water, rising up to considerably greater elevations in the centre of the city. It is about 120 miles from the sea at Monte Video. Its area is one of the greatest in the world, 44,830 acres. Paris has only 19,280; Berlin, 15,625; Hamburg, 15,681; and Vienna, 13,690. It would be a good day's journey to go around the city, as its perimeter measures 39 miles.

As far as the natural conditions permit the streets are laid out in the form of a chessboard, and are generally about 360 feet apart from centre to centre. In the central part of the city the streets are narrow; it is difficult for three carriages to pass. There are, however, a few 33 feet wide, and one or two avenues of about a hundred feet.

The finest, and said to be best-lighted street in the world, is the Avenida de Mayo, which is in the centre of the city as to the numbering of the houses north and south. It has a fine asphalt pavement and double electric lights in the centre. It was cut through the blocks a few years ago from the Casa de Gobierno (Government House), near the port to the 13th street, somewhat less than a mile. At the other end there is being built a beautiful capitol building that will cost about $5,000,000 (gold).

There are 72 parks and small areas outside the main streets, with a combined area of about 1,400 acres. These parks are more tastefully laid out and more neatly kept than can be found in any other country in the world, Paris excepted. In fact, in many respects the city, in its streets, lights, parks and structures, resembles Paris, except that there are more one-story residences than in Paris. The prevailing style is Spanish, with a patio (a kind of open area) and the rooms all facing it, and in this patio a garden and fountain, when the proprietor is able to have it; if not, pots of flowers very much like the ordinary city house in Mexico. The style of the houses of the wealthy may be seen on Avenida Alvear.

The pavements are wood (nearly all hard, suitable wood of the country), asphalt, granite blocks, macadam and rubble. No city has better pavements in the central part. In the outskirts, however, much of the pavement is very bad and uneven, merely rubble; but immense sums are being expended in substituting granite blocks and asphalt for rubble.

There is no city anywhere with more lines of street cars—in fact, with the exception of two streets, there is a line in every one of the principal thoroughfares. And leading out to the pleasant suburban towns—Belgrano, Palermo, and Flores—there are electric lines similar to those in American cities, using the overhead trolley. In fact, all the equipment from rails to trolley comes from the United States. Very extensive changes are being made in all parts of the city, substituting electric for horse cars. There are now 275 miles of street-car lines, which carried, in 1900, 116,447,982 passengers.

There is a project and a national concession for a system of underground electric tram lines, connecting the three main railway stations with the Plaza Victoria, and in one direction extending by a surface line far out in the country. If underground lines pay in any city in the world they will in Buenos Aires, for the conditions are especially adapted to their easy construction, the material being suitable for tunnelling, and a great mass of people crowded into the "Centre," with its narrow streets, where the present surface movement is often extremely congested. A United States citizen has the concession.

In 1868 there was a terrible epidemic of yellow fever, due, in a large part, to unsanitary conditions; but immediately afterward the city began a very extensive system of water and drainage works, costing thirty-three millions of dollars (gold), discharging the sewerage fifteen miles distant, and the storm waters, by great intercepting sewers, now being completed, into the river in front of the city. The city waterworks take their water above the city, where it is never contaminated. These works were designed by Messrs. Bateman and Parsons, of London, and the main construction was carried out under their supervision.

The water of the River Plate is good, but muddy, and it is clarified in settling-basins before being delivered to the distributing reservoir, built on one of the highest points of the city. The distributing reservoir is a work of art, covered with glazed tiles over pressed brick. These works all together have made Buenos Aires one of the healthiest cities in the world, as the death-rate proves.

Ten years ago, upon the completion of the main works, the mortality per 1,000 was 30; now it is 16½. This compares very favorably with other large cities. London has 19.2, Glasgow 21.6, Liverpool 26.3, Manchester 24.1, Dublin 30.4, Paris 20.1, St. Petersburg 24,7, Vienna 20.7, Madrid 30.1, Rome 17.6, Venice 22.8, New York 19.7, Philadelphia 17.7, Brussels 17.9, Boston 19.0, and New Orleans (white) 17.9.

The Government is soon to extend the works at a cost of five millions (gold).

The climate, taking the whole year round, is very equable and very agreeable. The parks are always green; vines and palms and a species of banana plants are seen everywhere, and flowers all the year in the open. It has a semi-tropical country in the north and in Paraguay from which to procure the plants, where the Victoria Regia and other beautiful plants grow wild.

In reference to education the primary education is compulsory from the age of nine to fourteen; secondary education, from fourteen to nineteen, is optional, as also the university, or higher education, from nineteen to twenty-five or twenty-six. No man can enter into any of the professions, including engineering, and take a prominent position in the Government without being a graduate of the National University and having taken the course outlined in the above division of ages.

In 1900 there were 450,000 pupils in the public schools, which are free to all, and free to people of all religions. Although the Catholic religion is the national religion, neither it nor any other religion is allowed to be taught in the schools.

In the National University there are four faculties—law and social science, medicine, exact physical and natural science, and philosophy and letters. In 1901 there were 3,562 students in the University.

In reference to religion all may worship God freely, according to the dictates of their own conscience. While the Government itself, like the Government of Great Britain, Germany, Switzerland, etc., recognizes an established Church and assists in its maintenance, it also often assists in benevolent and educational work undertaken by other denominations.

A very important work of this kind is the Argentine Evangelical Schools, initiated, promoted, and carried on by Mr. William C. Morris. The report of 1901, just issued, shows there were 1,820 pupils in various departments; in the previous year there were 1,076. This school is really a national school, and is assisted in a measure by Congress, although largely dependent upon private subscriptions, which are made to it by not only Protestants but by leading Catholics as well. It is devoted entirely to the education and care of children of the poor who cannot enter the public schools for want of suitable clothing.

The general style of the city is cosmopolitan—in buildings, in stores, in residences, in dress, in habits and customs of the people.

It is made up of many nationalities. According to the census of 1895, there were in the country about 3,000,000 Argentines (all children born there of foreign parents are Argentines) and about 500,000 Italians—by far the largest number of immigrants, and they are far better than the immigrants of the same nationality that come to the United States. Some of the best and most intelligent people in all kinds of business and industries, especially in agriculture, are Italians. Next come the Spaniards, about 200,000; next the French, somewhat less than 100,000; next the English, 22,000; next the Swiss, 15,000; and lastly the North Americans, as we are called, 1,400. These figures refer to the year 1895. The number of foreigners in the country December 31, 1899, was 1,199,808—an increase of 20 per cent. on the returns of the year 1895.

Immigrants in 44 years			1,935,077
Italians	"	"	1,198,550
Spaniards	"	"	361,079
French	"	"	162,636
British	"	"	34,031
Austrians	"	"	31,698
Germans	"	"	27,834
Swiss	"	"	24,873
Belgians	"	"	19,082

The history of the lighting of streets in the city is very interesting, and shows that the city keeps pace with others in this respect. The first record of public lighting was in 1778, when the city had lamps in the shape of a tin of horse-oil with a wick; then came tallow dips, then oil lamps; then came gas in 1885, and in 1888 electricity began to replace it in part; and on December 31st, 1900, the city was lighted with 889 arc lamps, 318 incandescent of 16 cp., 14,084 gas lamps, many with the Welsbach burner, and 8,590 kerosene lamps, and there were 36 electric light stations, with a capital of 9 million dollars (gold), and with a capacity of 23,300 electric horse-power.

In addition to telegraph lines there are four cable companies working with Europe and the United States. The service is very good and prompt; its time of transmission between Buenos Aires and London, "via Galveston" and Western Union lines and cables, is about 60 minutes, and with New York 30 minutes.

It is an interesting fact that the difference in level between the highest point on land of the lines of the Central and South Ameri-

can Telegraph Company and the lowest point of its cables in the Pacific Ocean is about 31,000 feet—six miles.

This company has three underground cables which cross the Andes and work uninterruptedly, though covered with snow for eight months of the year.

The telephone service is in the hands of private companies. The capital invested is over $10,000,000 (gold); there are about 11,000 subscribers. There are no real long-distance lines, except one recently opened to Rosario.

The house-fronts, when kept in repair and painted, are neat and architecturally beautiful. The words "repair" and "painted" must be explained. There are no wooden houses, which these words might imply; they are almost always made of rough brick, covered with what is called *revoque*, a covering of plaster or "staff," and sometimes artificial stone. The better class of houses generally have a base of granite, marble, or other natural stone three or four feet high, and then brick covered with revoque. Sometimes the natural stone extends to the second story, and then invariably comes the artificial covering; after a while—two or three years—this begins to discolor and flake off, requiring painting and repairing; after ten years it begins to become an eyesore, and at the end of twenty years it must come off at considerable expense. An instance to be cited is the American Church, Methodist Episcopal, which was built 25 years ago, but for five or six years past has presented such a dilapidated appearance that it has become necessary to remove the revoque from the sides and front from the base to the steeple and renew it at a cost of $10,000—a large sum for a poor church.

The means of locomotion about the city are abundant—street cars everywhere, and a very good and economical cab service. There are few coupés, no public hansoms, and only one or two private ones; but the street carriages are two-horse victorias, which carry four people. The private turnouts are equal to those of any city of the United States, especially the horses, which are of the best imported stock. The "Corso" and the approaches to it on a Saturday or Sunday afternoon are very attractive. It is in the beautiful park of Palermo, one of the suburbs—broad avenues, beautiful shrubbery, lakes and shady drives, and immediately in front the broad river Plate, whose further shore is beyond the horizon.

The people show great taste in the arrangement of their stores, and particularly the shop windows; from a butcher's shop to a con-

fectioner's and a lace store the fine French taste is visible everywhere. A walk along Florida, the principal shopping street—a fine asphalt street with no street cars in it—is one of the delights of Buenos Aires, and one never tires of it. If for a fortnight you miss this promenade you hardly know the street, for the appearance of the stores has greatly changed in the meantime by a complete change of the decorations.

The manner of living is Continental—a cup of coffee with a roll in the early morning; breakfast at 11 to 12.30 (which is a meal in courses), and dinner at 7.30, the principal meal of the day. This is the custom among all classes, high and low. And there is another custom (it is strange how soon you fall into it): tea or coffee or mate (a species of steeped herb—yerba—pressed into a peculiar little gourd used as a bowl and drawn out of it with a hollow silver tube called a mate stick). This 4 o'clock drink is as necessary as any meal. In the Government House (Casa de Gobierno) the Government provides tea or coffee for all of its officials and employés.

The foreign debt of the National Government in 1900 was $338,771,614 (gold), and the international debt $3,322,500 (gold). There are thirty different loans, the interest on which ranges from 3½ to 6 per cent.; the total interest charge in 1900 was $22,349,900.84 (gold). It requires annually, to pay the interest on the total debt, $18,661,864 (gold) and $11,695,218 (paper).

The total revenue of the Government in 1900 was $62,045,458 paper and $37,998,704 (gold).

It is generally known that in 1890 a terrible financial crash came upon the country, at the time of the Baring failure; since then it has had to struggle to carry the load imposed by the disasters of those days.

Besides Spanish, the national language, French, Italian, English, and German are spoken almost everywhere.

A brief résumé of the ocean commerce will give significant figures.

In 1899 the value in gold of goods imported into Argentine was about $117,000,000, and exported $185,000,000. Of these $44,000,000 imports came from Great Britain and $15,000,000 from the United States; Italy comes next with $14,000,000, and Germany next with $13,000,000; then France with $11,000,000, and Belgium with $9,000,000. But exports show a different distribution, for France took $41,000,000, Germany $29,000,000, Belgium $24,000,000, Great Britain $22,000,000, the United States $8,000,000, and

Italy $5,000,000. Of the foreign trade Buenos Aires had 87.2 per cent. of the imports, Rosario 8.8; La Plata 1.2, and Bahia Blanca 0.80. Of the exports Buenos Aires had 55.5 per cent., Rosario 18.4, La Plata 2.30, and Bahia Blanca 7.00. These ports are mentioned as some information about them is needed to explain the commercial situation. Of all the goods reaching the River Plate countries 80 per cent. comes to Argentine.

In 1885 the National Government began the construction of very large docks at Buenos Aires; hitherto all the business had been done from the anchorage, about 12 miles from the city, the intervening space being a great mud bar, the water from a depth of 25 feet gradually shoaling to the shore-line at the city. This was so flat that it was necessary often to transfer the passengers and goods from the lighters, with which they had come from the vessels, to small boats and to great wheel-carts that went out a long distance in the water to meet the lighters.

The new docks are very extensive, and lie along the immediate front of the city and connected with it; they were designed by the English firm of engineers Hawkshaw and Hayter and carried out under the supervision of Mr. James Dobson, the resident engineer. The concessionaire was an Argentine citizen, Mr. Madero; the contractors were the experienced English firm of Walker & Co., who built the Manchester Ship Canal. These men all deserve the highest credit for carrying through, under the financial difficulties of the period above mentioned, a great public work, costing $38,000,000 (gold).

In order to reach the docks from the sea a channel had to be excavated in the mud foreshore from the anchorage. This channel (the north one) is at low tide 21 feet deep and 330 feet wide, and about 5½ miles long from its intersection with a channel which already existed by previous dredging from the other end of the port, at the mouth of a small, sluggish stream called the Riachuelo, in which channel there generally is about 19 feet of water at low tide. The tide of 2 or 3 feet, depending largely upon the direction and force of the wind and very uncertain, permits vessels drawing about 23½ feet to enter the port by the north channel. The new port was connected with the older port, and now both channels are being used, and the depths in them are about as I have stated.

The Government has recently begun the extension of the north channel straight out to the anchorage, and later will deepen it to 22 feet. In the meantime the navigation uses a crooked channel

beyond the intersection, which has been partly dredged, curving round from the south channel to the anchorage. The depth of water in the northern entrance basin of the port is 21 feet, but in the four great docks 23 feet, with tidal gates so that the vessels at low tide may be afloat.

The works are built in the most substantial manner—masonry walls founded on what is called "tosca" (loess), the hard substratum that is found in this part of the country. The four docks, or basins, are from 620 to 750 yards long, and are all 170 yards wide, connected by passageways 22 to 27 yards wide, over which passes, by hydraulic turning bridges, the foot, vehicular, and rail traffic. A sea wall in front protects the entire port. On the city side are three and four story brick warehouses, 24 in all, with a total frontage of 1½ miles. Sheds, cattle yards, railroad tracks, hydraulic cranes and capstans, and other important appurtenances give the port modern facilities for handling cargo.

When the docks were opened at the southern end in 1899 the registered tonnage of vessels arriving and departing at the Port of Buenos Aires was 3,800,000; in 1901, 8,661,299—more than 100 per cent. increase. There are only twelve ports in the world of greater tonnage, and none of them show such phenomenal growth.

In 1880, about the time that the works were proposed, the tonnage was 644,570, and the plans were made for 2,000,000 tons only.

The extraordinary growth of the commerce has made it necessary to make an enlargement of the facilities, and this was one of the works intrusted to me during the last year of my stay in Argentine. With the proposed enlargement, the port will have free access from the sea and a depth of 26 feet.

The plan also provides facilities for "inflammables"—coal, petroleum, gasoline, naphtha, and some explosives.

The Standard Oil Company of New York is now arranging to bring bulk oil in tank steamers to Argentine, and the Shell Transport Company is preparing to make a specialty of the importation of fuel oil from Texas and the Dutch East Indies. The work of enlargement of the port is divided into sections, so that it can be carried out section by section as the increase of commerce will require. The general plan also includes the protection and deepening of the entrance channels.

One of the principal ports of the country is Rosario. Ocean navigation reaches it, and, for that matter, reaches Colastiné, the

port of the City of Santa Fé, the capital of the Province. The registered tonnage of the port of Rosario in 1899 was 3,000,000, of which more than 2,000,000 were over-sea vessels, about 700 per annum. The merchandise entered and cleared was about 1,650,000 tons; 67 per cent. of the exportation was wheat. In the busy months there are often over 30 vessels seen at one time along the wharves and the barranca, where the wheat is loaded in bags, sliding down from the high cliff 60 feet above the vessel. The imports amount to about $10,000,000 (gold), and the exports to $30,000,000.

The National Government is making a great port of Rosario, endowed with all modern facilities for handling cargo. It sent out to Europe and the United States a full report, with all necessary data, submitting the project to capitalists and contractors, with the request for propositions to build and operate the port. It will cost from $10,000,000 to $12,000,000 (gold).

The contract, after an examination of and report upon the projects presented by a Board of which I had the honor to be President, has been let to the well-known and experienced firm of contractors Messrs. Hersent, of Paris, associated with Schneider and Co., of Creusot, France. The works of construction were inaugurated by the President of the Republic on Oct. 26th, 1902.

The plans of the work have been based on the data above mentioned.

Some important problems had to be solved in connection with the improvement of so great a river as the Paraná, the bed of which is subject to such important changes, and also its islands and banks.

The front line of the proposed wharves is over 2½ miles long. The masonry piers must go down into the tertiary sand below the scour of the river, and their foundations will be from 60 to 80 feet below the low-water level.

The importance of this work, furnishing a modern seaport to the second city of the country, can scarcely be overestimated. In my report on the project made in Sept., 1900, I used the following words, which two years of subsequent study have corroborated:

> It is safe to say that the establishment of a first-class port at Rosario, with suitable channels of access, will revolutionize completely the commerce and industry of this Republic.

La Plata port and city were built by the Provincial Government, when, in about 1880, the National Government came to Buenos Aires to occupy it as the capital of the nation. La Plata is an

excellent port; it is built on the shore of the Rio de la Plata, about 35 miles from Buenos Aires, and cost about $14,000,000 (gold). The opening of the national port at Buenos Aires has driven most of the commerce from La Plata; but it is capable of being made, with a comparatively small sum of money, deep enough, in its entrance channel (five miles long) and in its port areas, to accommodate vessels of 26 feet draught at low tide; it now has 21 feet.

The remaining port of importance and rapidly growing is outside of the River Plate, in the south, Bahia Blanca; it is the principal shipping port of agricultural products by the great Southern Railway, the largest system in the Republic. This port is in an estuary of the ocean, and is a protected harbor; in fact, the terminal of the railway is about 35 miles from the open ocean. The Railway is building a steel pier, 1,640 feet long, with spacious warehouses and 19 miles of siding; and there will be, when all works are completed, over half a mile of wharf frontage, supplied with electric cranes.

The National Government is building in this estuary at Puerto Militar, or Puerto Belgrano, a system of dry docks and basins on a large scale. The first dry dock, one of the best and largest in the world, is completed and now in use. It was designed and built under the immediate supervision of the well-known Italian engineer, Chev. Luigi Luiggi, who had charge of similar work at Genoa.

This dock, built of first-class materials and upon the most modern methods, can take the largest naval or merchant ships of the world, as it has a useful length of 713 feet and an entrance width of 85 feet, and a depth over the sill of 32½ feet at mean high tide, 22 feet at low tide. It has intermediate gates, so that two or three small vessels can be docked at the same time or separately.

The plans, photographs, and possibly a relief model of this dock will be exhibited at the World's Fair in St. Louis in 1904.

In October, 1902, the U. S. battleship Iowa, the flagship of the South Atlantic Squadron, was docked at Puerto Militar.

It is gratifying to know that at Buenos Aires there is a large business with New York by means of five steamship lines, and, through New York, with Chicago and other cities, from which are shipped a large amount of agricultural machinery of all classes—from cultivators and ploughs to great steam threshing machines of the J. I. Case Co., of Racine, Wisconsin. Not only from Chicago but from all manufacturing districts the trade of our country is increasing. You see our machinery everywhere, and it is everywhere considered equal to any—Baldwin locomotives, Jackson and Sharp cars, and Harlan and Hollingsworth's. The American

freight car of 25 and 30 tons is replacing the old Belgian, French, and English 7 and 10-ton cars. If the American cars are not all made in the United States they are copied from ours. The most approved bridges are from the United States. Large quantities of Southern and Oregon pines are imported. From the United States comes all the kerosene used. I might go on enumerating many other United States products. I can well say that the prospects of American trade with Argentine are exceedingly good.

The Argentine Government is determined to improve the great rivers of the country by methods which have been found to be best in other countries under similar conditions. The results of our experience upon the Mississippi are being closely watched, studied, and applied. The reports of the Mississippi River Commission are of great value to that country. I may further say that the Argentine engineers and the methods pursued by them are equal to those of any country. Every Government engineer, to take a prominent position, must have a diploma from the Engineering Department of the National University. The graduates of this excellent school are as well equipped for their work as those from any school in the world; this I know by experience, for four of them (young men) have been associated with me as my immediate assistants, and in my position as consulting engineer of the Government I have been brought into close relations with many other engineers and I have the highest opinion of their ability.

The Sarmiento School commemorates one of the most learned and best of Presidents, who, when he was Minister at Washington, engaged a large number of our young lady teachers to go to Argentine as Normal School teachers. Many of them are there yet after nearly twenty years' service—a service that has reflected honor upon themselves and their country.

In two years of close relations with the country, and especially with the Government officials, I formed a very favorable idea of the character of the people and of the possibilities of business and profitable enterprise for our own people there. The officials of the Government and the leading men of the country desire to have us come to Argentine with business energy, integrity, and ability to help build up that great country of South America, so like our own in its climate, soil, rivers, coast-line, and other general features.

THE CITY OF ROCKS.

BY

U. FRANCIS DUFF.

A remarkable natural curiosity of the Southwest is the "City" of Rocks, near Hudson Hot Springs, in southern New Mexico. Here, rising from a ridge of solid rock, and extending over about two hundred acres, is a great mass of lofty domes, crags, columns, peaks, shafts, spires, and pinnacles, through which run many openings and passageways, corresponding in a certain degree to the avenues, streets, and closes of a town. From the main passageways hundreds of little alleys, many so narrow that one is put to it to squeeze through them, branch in all directions. These are so numerous, intricate, and winding in their confusing mazes that it would require considerable time for one to familiarize himself with them. All of this is interspersed with little plazas, or open courts; while on the outer edges are several semi-circular and triangular bays, which extend up into it from the surrounding plain.

It is evident that a long ridge of rock extending the length of the place was forced up here at some time in the bygone ages—a past so remote as to be beyond conjecture. This rock was a formation of different degrees of hardness, the portion in contact with the seams, or veins, running lengthwise and across it having been so much less refractory than the rest as to have been worn away in the course of the long cycles of time that have rolled by, or, it may be, because the elements could more easily reach these parts.

It is possible that the glacial period has been a factor in the work; but it is more than likely that the slow but sure disintegrating processes of time—the wind and the rain and the continuous chemical action of the atmosphere—have produced this most remarkable formation, second in grandeur and interest, so far as I know, only to the Garden of the Gods in Colorado. In some respects it is even more striking than the latter, the mass being so much greater.

The domes and towers shoot up in many places to a height of from fifty to sixty feet. Very few of these have sharp points or edges, the material of which they are composed being of such a nature—so easily affected by the elements—that the outlines have been worn away and softened down. Nor does this detract from

their picturesqueness and impressiveness. All are more or less honeycombed, and the wearing-away process still continues. From cells whose cups extended some distance into the rock I took out handfuls of the more friable material which had once filled them.

Sphinx-like and immutable they stand, the sentinels of the centuries, keeping watch and ward as the seasons have come and gone in this dun land of the wide horizon with its ineffable haze. The warm sunlight shimmers down upon them, bathing the lofty cones in its tender radiance; the little winds creep up, whispering across the wastes; but out of the brooding loneliness comes no voice to tell their story.

That the "City" was known to the Indians in prehistoric times is evident by the remains found within its limits. From a mass of

EAGLE CRAG IN THE DISTANCE.

débris covering the bottom of a dark cavern formed by the falling together of three great peaks was exhumed a number of relics and a skeleton in a fairly good state of preservation. Just outside of this cavern mortars have been cut in the main ledge. On a bench, in a great cavity hollowed out of one side of Aztec Rock, a body had been laid away and enclosed with a substantial wall composed of flat stones set in adobe mortar. This had been opened and the remains carried off some years prior to my visit, but a portion of the wall is still standing.

The streets stretch away, in many cases, in almost perfect line, although the view is more frequently interrupted by sharp turns

and windings. These generally trend north and south or east and west. Some of them are fifteen or twenty feet wide.

The rocks have assumed many curious and fantastic shapes. The Leaning Tower, Balance Rock, the Cardinal's Hat, and another, something like a kneeling camel in appearance, are very striking. Two little pinnacles on the west side, known as Twin Pillars, are also quite interesting. At the northwest corner is a massive dome called Eagle Crag, in a large pocket of which a pair of eagles have nested for several seasons and successfully reared their broods.

CAMEL ROCK.

To attempt a description of all of the attractive features of the "City" would be a task requiring a perfect familiarity with it—something that could only be obtained through long and careful investigation.

The visitor will find, at every step, something new to attract his attention; a score of openings, leading in as many different directions, will invite him, until, bewildered, he finally sits down to rest and gather together his scattered wits.

Some idea of the confusing magnitude of the place may be obtained from the fact that the writer spent more than an hour trying to find Aztec Rock, which he had visited the day before, and the general location of which he had quite distinctly in mind. Providing one has a very sure-footed animal, it is possible to ride a horse over most of the "City," although swinging around the edges of great crags and climbing steep inclines are apt to be a little trying on the nerves.

A man named Couch has filed a homestead claim on one hundred and sixty acres of the site; but owing to its remoteness, it will not be of great advantage to him, even should he fence it in, as I understood he contemplates doing. If possible, it should be set apart by the Government.

THE ISLAND OF GUAM.

This map of the Island of Guam is reduced from the map published by the War Department, the result of the Government

GUAM.

survey. The facts here given with regard to the island are taken from Brig.-Gen. Joseph Wheeler's report on Guam, published by

the War Department, and the article by Mr. W. E. Safford in the last report of the Smithsonian Institution. These reports embody the best and latest information that American investigations have made accessible.

The island is twenty-nine miles long and from three to ten miles wide, with an area of about 150 square miles, or seven times as large as Manhattan Island. It is four days' steaming to the east of the Philippines. Little is known about the interior; for the jungle is so dense that not even the natives have penetrated far into it, except in two or three places, where paths extend from coast to coast. A fine view of the northern third of the island is obtained from the summit of the low mountain, Santa Rosa peak, which is easily reached. All the inhabitants live along the coasts, and most of them along the west coast. The natives have cleared away a narrow strip of the jungle, bordering the sea, for their plantations.

A chain of low mountains, scarcely over 1,000 feet high, stretches along the southwest and south coasts, some twelve miles, and from two to three miles in the interior. Guam, like all the other islands of the Ladrones, of which it is the southern and the largest member, was built up partly by outpourings from volcanoes and partly by the work of coral insects. It has this advantage over the islands to the north, that its volcanoes are all extinct; while there are still eruptive mountains on some of the more northern islands. Guam is, however, subject to severe earthquakes.

The northern half of Guam consists almost wholly of coral rock, which is very porous, so that the rain sinks immediately into it, and makes its way by underground channels to the sea; thus there are no springs or rivers in the northern part of the island. Near Agaña, the capital, however, is a large spring, yielding a copious water supply, which oozes through a swamp and widens into a river. Near the sea it has been artificially lengthened and turned for a mile, parallel to the coast, for the convenience of the natives. This is one of the reasons why two-thirds of the population is centred at Agaña. Some of the streams in the southern part of Guam lose themselves beneath the surface for a time, and then reappear from limestone caverns.

Nearly all the inhabitants, though farmers, live in the towns, and go out to their ranchos to raise their crops. Most of the entire population of about 9,000 is distributed among six towns: Agaña, containing 6,400 inhabitants; Sumai, 900; Ynarajan, 550; Agate, 400; Merizo, 300; and Umata, 200. A number of hamlets, each containing a few huts, are also distributed along the shores.

SURVEY OF THE UNITED STATES.

Agaña, the metropolis of the island, achieved its pre-eminence by reason of its abundant water supply, although there is only a roadstead in front of it, with unsafe anchorage. San Luis d'Apra is the largest harbour of the island, with a number of small towns along its extensive shores. Port Tarofofo, on the southeast coast, is the only harbour next to San Luis which can receive vessels at all seasons of the year. Port Ynarajan and Agfayan Bay have good anchorage, and are of some importance in the coprá trade. Umata was once important commercially; but, since its destruction by an earthquake in 1849, Agaña has forged far ahead of it.

The towns of the west coast are connected by paths or roads. The road from Agaña to the north passes through an especially fertile country; and there are two passageways across the island—a fairly good road from Agaña to Pago and a poor path from Apra, diagonally across to Ynarajan.

The gentle Chamorros, the aboriginal inhabitants, have heartily welcomed the advent of the Americans. They are lighter in colour than the Filipinos, fully clad, subject to few diseases, and cheerful in disposition. They procure their food from the farms or the sea, live in very well-built houses, many of them of stone, and manufacture at home most of the things they need. Many of them are half-breeds, their fathers being American and British whalers, whose visits are now very rare. The influence of the Roman Catholic missionaries, who have lived among them for generations, has been favourable; and the Caroline Islanders, about 100 of whom came to the island as farm labourers and now till their own little farms, are far behind the natives of Guam in civilization.

TOPOGRAPHIC SURVEY OF THE UNITED STATES.

During the twenty-three years' existence of the Geological Survey it has mapped thirty-two per cent. of the area of the United States, exclusive of Alaska; or, in other words, there have been mapped to date 967,000 square miles of the country, on scales ranging from four miles to an inch, two miles to an inch, and one mile to an inch, up to large-scale detailed surveys for special areas.

During the past season there were in the field over ninety separate parties. These were working in thirty-four different States and Territories, including Alaska, and comprised a force which included eighty-two topographers, ten other party chiefs, and about

three hundred temporary assistants. This force mapped, in round numbers, 20,000 square miles, on the scale of about two miles to an inch, with relief, shown by contours, having intervals varying between twenty and one hundred feet; and 17,000 square miles on the scale of one mile or larger.

While nearly one-third of the area of the country has been mapped, the progress is apparently at the rate of but one per cent. of the country per annum, at which rate it would require nearly eighty years yet to complete the map of the United States. On the other hand, the absolute amount of work accomplished is great; for thirty-seven thousand square miles make an area as great as that of Indiana, or of South Carolina and Connecticut together. As compared with the areas of European countries, it would be equivalent to mapping annually Portugal, or Belgium, Denmark, and the Netherlands combined.

During the year the results in the more important sections of the country were as follows: In Maine, 215 square miles were mapped on the upper Kennebec, and a complete topographic survey, accompanied by careful spirit levels, was made of the entire Kennebec River to the Moosehead Lake outlet. In New Hampshire an equal area was mapped in the neighbourhood of Manchester and Nashua; in Vermont, a like area between Middlebury and Vergennes.

In New York over 2,500 square miles were mapped, chiefly in the Adirondacks, Western New York, the Catskills, and on Long Island, where the entire survey was completed, and the results will soon be engraved for final publication. In the neighbourhood of Plainfield, Morristown, Somerville, and High Bridge, New Jersey, the old State survey maps were revised to bring the culture, such as roads, houses, etc., up to date over an area of about 800 square miles.

In Pennsylvania an area approximating 800 square miles was mapped in the neighbourhood of Johnstown and in and about Pittsburg. The latter map was made on the large scale of two thousand feet to one inch, which permitted of showing every house, factory and other building, street and trolley lines, and resulted in the completion of the first connected map of that region. In Ohio about 3,000 square miles were completed, including particularly areas about Ashtabula, Akron, Kent, Marion, Hamilton, Athens, etc. In West Virginia an area of 1,800 square miles was mapped, chiefly in the northwestern portion of the State, including the region in which coal, oil, and other mineral resources are being developed.

In North Carolina and Georgia surveying was extended in each case over about 600 square miles. In Tennessee nearly 1,000 square miles were mapped southwest of Nashville; and in Kentucky an equal area in the Blue Grass country south of Lexington and in the mountains near Middleboro. In Louisiana an area of nearly 1,000 square miles is still under survey immediately north of Baton Rouge.

In the Central States about 500 square miles were mapped in Indiana near Evansville and in Iowa near Decorah; in Wisconsin, about 500 square miles near Richland Center, and an equal area near Racine and Koshkonong; in Michigan, 800 square miles between Ann Arbor and Detroit. About Independence, Kansas, about 1,000 square miles were mapped, and 300 square miles in the neighbourhood of Bonne Terre, Missouri. In Arkansas 500 square miles were mapped immediately west of Eureka Springs. A resurvey on the large scale of 2,000 feet to an inch was completed of an area of 500 square miles about the city of St. Louis. The publication of this is to be pushed with all vigour, with a view to completing it in time for printing and distribution at the World's Fair in 1904.

In the Far West a large amount of work was in progress in the vicinity of Circle City and the Nome peninsula, Alaska. In Arizona detailed mapping of a portion of the Grand Cañon of the Colorado is in progress, besides the survey of about 250 square miles near Tucson and of 1,000 square miles near Nogales. In Colorado topographic surveying of 150 square miles was completed near Georgetown, and large-scale special maps for the study of mineral resources were made in the neighbourhood of Cripple Creek and Lake City. In Utah 100 square miles were mapped in the Uinta Mountains, and a large-scale special map made near Cottonwood, on the summit of the Wasatch Mountains. In Texas an area of 500 square miles was mapped in the Chicos Mountains. In Montana about 300 square miles were mapped in Flatwillow County. In Wyoming in the neighbourhood of Laramie and Sherman there was mapped an area of about 1,300 square miles. In Oregon about 500 square miles of Union County were completely surveyed. In Washington the survey was in progress, or was completed, of about 2,600 square miles in the neighbourhood of Mt. Adams, Chapaca, Oakdale, and Okanogan.

In the State of California there were mapped about 1,500 square miles in Santa Barbara, San Luis Obispo, Tulare, and Fresno Counties. In this State there were also made special large-scale sur-

veys for study of mineral resources in Shasta County, about Bully Hill and Little Backbone. Mapping in the Sacramento and San Joaquin valleys will be continued throughout the larger part of the winter.

No unusual topographic features or unknown regions were developed by the surveys of the past season. Some interesting forms were mapped, and facts of interest to the geographer and the geologist will be made evident by the resulting atlases, notably in the detailed surveys about Bright Angel, the tourists' region of the Grand Cañon of the Colorado. The intricate forms resulting from the erosion of this gorge are beautifully portrayed on the map, and give quite a different idea of the topography as compared with that in the earlier exploratory maps.

Of almost equal interest are the maps of the southern shore of Lake Erie and about Detroit, because of the light they throw on the various stages of the Great Lakes as depicted in the outlines of the old beaches.

The map of the vicinity of Pittsburg is one of the most interesting ever made. The topography shows a highly-eroded plateau, and the various rivers are bordered by steep bluffs, upon the sides and slopes of which have been built a series of cities which for density of habitation and congestion of streets, buildings, and railroads is hardly paralleled anywhere, when the abruptness of the mountain slopes is taken into consideration.

In addition to the topographic mapping described a large amount of geodetic control, both by primary triangulation and primary traverse, was extended throughout various unmapped areas of the country. This is to serve as a basis upon which to develop topographic surveying. It consisted in determining by geodetic methods the astronomic positions of important points, as mountain summits, church spires, etc.

In the East a belt of triangulation was extended from near Burlington, Vermont, to the Canadian line. In New York primary traverse was run to control scattered areas between Rochester and Buffalo and east of Oswego. In Pennsylvania similar control was extended to the eastward of Philadelphia and in the northwestern corner of the State. In Ohio similar control was extended along the western State boundary throughout half its length to the northwestern corner of the State, as well as scattered areas elsewhere. In West Virginia primary triangulation was extended between Charleston and Elizabeth. In Kentucky primary traverse was extended southeast of Owensville; in North Dakota, over

an area of about 2,000 square miles between Fargo and Grand Forks.

In the western United States more extensive areas were controlled by primary triangulation. In Montana a belt of triangulation was extended down the Milk River for over 100 miles from Fort Assinniboine. In Wyoming a belt was extended across the State from north to south between the neighbourhoods of Laramie and Buffalo; in eastern Washington, from North Yakima through Yakima, Douglas, and Kittitas Counties to the international boundary. In eastern and central Oregon large areas were similarly controlled in Grant, Harney, and Malheur Counties, and in the famous Modoc lava-beds country. In Arizona a belt of triangulation was extended from the neighbourhood of Florence, *via* Tucson, to the Mexican boundary near Nogales.

Throughout the various regions in which topographic mapping was in progress there were run about 17,000 miles of very accurate primary levels, and 25,000 linear miles of secondary levels of less accuracy, for the location of contour lines upon the topographic maps. Some precise levelling was extended near the Pacific coast in the upper Sacramento valley, with a view to reducing the spirit-levelling to mean sea-level datum. In connection with all this spirit-levelling many thousands of bench-marks were established, which will serve as reference points for engineers and others who may have to make use of careful levels in connection with their work.

H. M. W.

THE PANAMA CANAL IN ITS COMMERCIAL ASPECTS.

BY

EMORY R. JOHNSON.

As the beginning of the actual work of constructing an Isthmian canal seems to be close at hand, the present is an opportune time for making a careful study of the commercial aspects of the great waterway. The purpose of the present paper is to consider the effects which the canal will have on commercial routes and the volume of traffic that will make use of the waterway at the commencement and during the early years of its operation.

The use that will be made of the canal will depend upon the

economies resulting from the opening of the new route. The saving that will be possible consists to a small extent of a reduction in insurance charges. A considerable share of the traffic that will be diverted to the new route now passes through the Straits of Magellan by steamers, or around Cape Horn in sailing vessels. Just how great a reduction in insurance costs will take place is impossible to predict, but estimates of a saving of 25% to 50% have been made by those engaged in insurance business.

The greater efficiency which shipping will possess because of the shorter and more expeditious route will be an advantage the amount of which cannot be fully measured by the economies resulting from lower insurance charges or by the shortening of distances, to which reference will presently be made. To a considerable extent ships are operated as a part of business enterprises, and the fact that a vessel can make more trips and handle more tonnage in a year not only reduces the amount of capital that must necessarily be invested by a business concern, but also enables the business in question to be carried on under more favourable circumstances. When there is a large surplus of vessels seeking employment this advantage is not important; but when there is a scarcity of shipping, as not infrequently occurs, the ability to make voyages quickly and to handle a large amount of traffic with a relatively small tonnage of vessels is of much importance.

The most important saving effected by the canal will result in the shortening of distances. This economy, however, will be in part offset (1) by the delay incidental to passing through the canal, (2) by the tolls charged for using the waterway.

The time required for making the transit from the Caribbean Sea to the Bay of Panama by way of the Panama Canal will average about 12 hours. Small ships can make the trip in less time; while the largest vessels will take somewhat more than twelve hours for the trip between Colon and Panama. Any vessel arriving at either terminus early in the morning can make the passage through the canal during daylight of the day of arrival. A vessel arriving in the evening or during the night can also proceed on its trip through the canal, provided the canal is thoroughly lighted, as it presumably will be. It is probable, however, that vessels of the largest size will prefer to wait a few hours in order to make the passage by daylight. On the average, a vessel will be detained somewhat less than a day, including the passage through the canal.

The question of tolls and their influence on traffic can best be considered in connection with a discussion of distances. A care-

ful study of the effect of tolls upon the traffic of the American waterway indicates very clearly that the charges must be placed much lower than the Suez tolls. The charges at Suez are 8.50 francs per ton net register, Danube measurement; but as this measurement makes the net registry of vessels average about 20% more than when measured according to British or American rules, the charge for using the Suez Canal amounts to about $2 per ton net register, according to our methods of determining tonnage. For some of the traffic available for the American canal such a charge would be prohibitive.

The saving in distances that will result from the opening of the Panama Canal was fully set forth in the BULLETIN of last April. The facts there presented make possible the determination of the territorial limits within which the Panama Canal will be able to draw its traffic, and enable a statement to be made of the amount of tonnage which the commerce within those limits may be expected to send through the waterway. The effect of the canal upon the diversion of traffic may be indicated by considering the subject under six heads:

1. The commerce of the western seaboard of the United States —including Hawaii—with the Gulf and Atlantic ports of the United States and with Europe may be considered as certain to use the new canal route. The shortening of the distance will be so great as to leave no doubt of the diversion of traffic from existing lines to the new route even were the tolls placed as high as those charged at Suez.

2. The commerce of Western South America with the Gulf and Atlantic sections of the United States will also be entirely diverted through the Panama Canal. The distance from New York through the canal to a port as far south as Valparaiso will be 3,850 miles, or 45%, less by way of Panama than *via* the Straits of Magellan; and between the ports of our coasts south of New York and the cities on the west side of South America north of Valparaiso the absolute and percentage reduction in distance will be much greater. Here, likewise, a toll of as much as $2 per ton might be charged without keeping the traffic away from the new route.

3. The commerce between the eastern seaboard of the United States and the Asiatic ports north of Hong Kong will be practically certain to make use of the Panama route, provided the tolls are not made exorbitant. The distance to Shanghai *via* Panama will be 2,000 miles less than by Suez. From New York to Yokohama the new route will save 4,000 miles.

4. The effect of the Panama Canal upon the traffic between Europe and Western South America merits especially careful consideration in connection with the effects of tolls. The influence of the proposed route upon commerce can be measured to advantage by referring to the nitrate of soda exports from Northern Chile. Three-fourths of the Chilean export tonnage consists of nitrate, the deposits of which are located in the middle part of the western coast of South America. The average distance from the ports of Northern Europe—Antwerp, Hamburg, Liverpool—to the nitrate deposits will be shortened about 2,800 nautical miles. The present distance by way of the Straits of Magellan will be reduced about 30%. A saving of this distance would shorten the time of the voyage for a 10-knot steamer 11 days 16 hours. As the passage through the canal will detain the vessels somewhat less than a day, it may be said that the Panama Canal will reduce the trip for steamers between Europe and the nitrate beds about 11 days. A vessel operated at a speed of 9 knots an hour (which is the present speed of a large share of the tramp steamers) would shorten the time of the voyage nearly 13 days. Careful calculations of the net economy resulting from a reduction of 11 to 13 days in the time of making voyages between Europe and the central ports of South America indicate that it would be profitable for steamers to abandon the present route by the Straits of Magellan in favour of the Panama route. At the present time the largest part of the nitrate is carried in sailing vessels whose route is around Cape Horn. It is, however, not probable that a very large percentage of this traffic can be economically handled by sailing vessels by this circuitous route after the canal becomes available for steamers, provided a toll of not more than $1 per ton net register is charged for the use of the canal. A higher charge than this would doubtless cause many steamers to hold to the present Straits of Magellan route, and sailing vessels to continue to compete indefinitely with steamers for this bulky traffic.

5. The commerce between the eastern seaboard of the United States and Australia now goes around the Cape of Good Hope. The distance by the Suez and Cape routes is practically the same; consequently, when the American canal is opened the competition for the New York–Australia trade will be between the Isthmian Canal and the Cape of Good Hope routes. The distance from New York to Sydney *via* the Panama Canal and Tahiti will be 9,852 nautical miles; by the Cape of Good Hope, Adelaide, and Melbourne the distance to Sydney is 13,658 miles, the distance in

favour of the American isthmus being 3,806 miles. A 10-knot vessel would save about 15 days by taking the American canal route, and certainly would prefer that passage if tolls did not exceed $1 per ton net register. Practically, all vessels going to Australia, whether from Europe or the United States, call at Sydney because it is the most important port, and because coal can be obtained there or near by. For the trip from New York to Melbourne the Panama route would save about 11 days, and a toll of $1 could profitably be paid to accomplish this. There is, then, no doubt that steamers outbound from the Eastern section of the United States to Australia will prefer the American canal route with a toll of $1. The course taken by the vessels on their return will naturally be determined by the destination of the Australian exports. The ships that secure a whole cargo for America will return by the American canal. Likewise, those vessels that secure a partial cargo for the United States and a partial cargo for Europe will return by the Panama Canal. Steamers securing a full cargo for Europe in Australian ports will probably return by the Cape of Good Hope, although cheaper coal in American stations might cause the American canal to be used. The distance from Sydney to Liverpool by way of the American canal is only about 200 miles longer than the route by way of Melbourne, Adelaide, King George's Sound, Colombo, Adelaide, and the Suez Canal.

6. The effect of the Panama Canal upon the routes followed by the trade of our eastern seaboard with the Philippines will depend very largely upon the amount of tolls charged. Low tolls will divert a considerable share of the traffic from the Suez route to the one across the Isthmus of Panama. The distances from New York to Manila by the two canals are practically the same. From our South Atlantic and Gulf ports the distance to Manila is considerably less by the Panama route. Chartered vessels outbound from New York will doubtless go sometimes by one route and sometimes by the other. The chief attraction of the American route will be the coasting trade of both seaboards of the United States, the shortest route from the American isthmus to Manila being by way of the great circle which passes close to San Francisco. It will accordingly be possible for vessels sailing under the American flag to follow the course of the heaviest traffic movements—*i. e.*, to load with heavy manufactures or with other cargoes from the Atlantic or Gulf ports for the western ports of the United States; thence to take American grain and other food-products and manufactures to the Orient and the Philippines, and to load back for the United

States with hemp or other cargoes from the East. The coal obtainable in the Caribbean and Japanese stations will be inexpensive, and the American canal will have special facilities for competing with the Suez Canal, particularly if the American canal tolls are made less, as they unquestionably will be, than those charged by the Suez Canal Company. The Philippine Islands are so nearly antipodal to the eastern seaboard of the United States that the route taken by the commerce between the two sections will be determined almost entirely by the relative rates of tolls prevailing at the two waterways.

In view of the fact that the largest part of the Suez traffic can afford to pay a high toll rather than abandon that route, it is not probable that the Suez Canal Company will find it profitable to make a radical reduction in its charges—50%, for instance—in order to hold the commerce of the regions situated on the margin of advantage as regards the use of the eastern or western canal routes. Consequently, it would seem that the adoption of moderate tolls—not to exceed $1 per ton net register, American measurement—for the use of the American canal will enable that waterway to secure a large share of the commerce carried on between sections so situated that their trade with each other can choose between the Suez and American routes.

In general, it may be said that there is but little of the available Panama Canal traffic that would be kept from using the waterway by a toll of $1 per ton net register. The European trade with Western South America and the commerce of our eastern seaboard with Australia and Asia north of Hong Kong will not be driven from our canal by a toll of that amount, but it seems probable that a higher charge than $1 a net register ton would considerably restrict the other categories of traffic discussed in the foregoing paragraphs. A toll that largely restricted the traffic of the canal would limit the industrial and commercial value of the new route and deprive our country of many benefits it would otherwise secure. A toll of $1 a vessel ton net register would yield an income sufficient to pay the expenses of operation and maintenance and a moderate return on the capital invested, as the following statement of tonnage will show. Should the United States prefer to levy tolls sufficient only to cover the costs of operation and maintenance a tariff of 40 cents or 50 cents a ton will undoubtedly be sufficient.

The Tonnage of Canal Traffic.

In 1900 and 1901 the writer, while serving as a member of the Isthmian Canal Commission, made a detailed investigation to deter-

mine the traffic available for the canal during the year 1899, the latest year for which statistical material was available. Two investigations were made—one to determine the tonnage of freight or cargoes that would have used the canal during 1899, and the other to ascertain the net register tonnage of vessels that would have passed the canal during that year.

In the study of *cargo* tonnage special difficulties were encountered, because the available statistics compiled and published by the United States and other Governments do not give the weight of commodities exported and imported. In the case of our own statistics values are given for each of 328 classes of exports and 333 classes of imports. In some instances quantities as well as values are stated; but the weight corresponding either with values or quantities had to be determined by correspondence with exporters and importers in different parts of the United States. The conversion of the figures for values and quantities into their accurate equivalents in weight or tonnage was a laborious undertaking, which, however, was carried through with great thoroughness and detail.

It was found that the traffic of the two seaboards of the United States with each other and with the sections of the world with which our commerce would have unquestionably been carried on through a canal, had there been one in existence, amounted to 3,435,887 cargo tons in 1889. The value of this traffic was $127,-716,000. The commerce of Europe with the western coast of Central and South America, with Hawaii and British Columbia, in 1899, comprised 3,266,654 cargo tons. The sum of these two totals is 6,702,541 tons. These figures do not comprise any commerce between Europe and the western coast of Mexico; nor do they include any of the trade between Europe and Eastern countries, a part of which would, for reasons stated above, have passed through the American canal. It will be understood, moreover, that the figures apply to the commerce of the past carried on under conditions then prevailing. They do not refer to the commerce of the future, which, when the canal is opened, will be carried on under very different circumstances.

The tonnage of the *vessels* that would have used a canal in 1899 was ascertained by a study of the statistics of entrances and clearances compiled by the United States and European countries. Unexpected difficulties were encountered in this inquiry, arising from the fact that different countries follow different rules in the compilation of entrance and clearance statistics, and also because it

was necessary to be on one's guard against duplication. Great care was taken to avoid this, and to make certain that the statistics should err, if at all, on the side of under-statement rather than of exaggeration.

The following table summarizes the vessel tonnage which the commerce of America and of Europe with America might have contributed to a canal in 1899:

SUMMARY OF ENTRANCES AND CLEARANCES, COMMERCE OF EUROPE WITH PACIFIC AMERICA, AND COMMERCE OF EASTERN SEABOARD OF THE UNITED STATES WITH PACIFIC COUNTRIES, 1899.

Europe with	
Western South America	1,771,853
Western Central America and Mexico	140,000
Pacific Coast of United States, British Columbia, and Hawaii	642,180
Eastern Seaboard of United States with	
Western South America and Hawaii	166,364
Pacific Coast of the United States	109,312
Trans-Pacific Countries	908,140
Panama Traffic (1898)	336,998
Total	4,074,852

In addition to this tonnage, which comprises only traffic originating or terminating in America, there should be included most of the commerce of Europe with New Zealand and the other islands of the Pacific east of Australia. New Zealand will be about 1,500 miles nearer Liverpool by the Panama Canal than *via* the Suez route, and about 2,400 miles nearer than by way of the Cape of Good Hope. The distances to Liverpool from the most important groups of South Pacific Islands north of New Zealand will be from 500 to 5,000 miles less *via* the Isthmian Canal than by way of Suez. The entrances and clearances of New Zealand's trade with northwestern Europe, France, and countries farther north amounted to 481,178 tons net register in 1899, and the commerce of that part of Europe with the other islands of the South Pacific east of Australia to 181,743 tons. Of this total traffic of 662,921 tons not less than 500,000 might have advantageously used an Isthmian canal, and this amount should be added to the tonnage of the canal traffic originating or terminating in America. This makes the total obtained by the Commission's investigation of the tonnage that

might have used an Isthmian canal, in 1899, 4,574,852 tons net register.

The above totals for the tonnage that might have used an Isthmian canal in 1899 do not include any of Europe's trade with Australia and Japan, a part of which would have used an Isthmian waterway. The distance from Great Britain to Sydney and Yokohama by the Suez and Isthmian Canal routes is approximately the same, and vessels going by America in either direction *en route* between Europe and Japan or Australia will pass regions from which there is a heavy export tonnage. If it be assumed that only 10 per cent. of the vessel tonnage of the Australian trade with the ports of northwestern Europe and only 5 per cent. of the tonnage of the Japanese commerce with those ports would have taken an American canal route the total for 1899 should be increased 316,-223 tons, and be raised from 4,574,852 to 4,891,075 tons.

It was, fortunately, possible to compare the results of the two investigations made for the Canal Commission with the figures for canal traffic that had been determined by the New Panama Canal Company as the result of an elaborate study of vessel movements which that company had carried on continuously from the beginning of 1894. The method employed by the New Panama Canal Company was to make a list of all the vessels of the world, to keep a record of their movements, and at the close of each year to summarize the tonnage of those vessels whose movements had been such that they would have passed through the Panama Canal had there been one in existence. This elaborate and excellent study showed that a total traffic of 5,001,798 tons net register would have passed through the canal during 1899. The figures obtained by the New Panama Canal Company were slightly in excess of those resulting from the investigation made for the Commission by a study of entrances and clearances; but the two totals corresponded as nearly as could have been expected, in view of the differences of the methods employed, and in view of the fact that the two periods covered were not exactly synchronous. In each case the total approximated 5,000,000 tons.

The prospect is that the canal will be completed and ready for traffic by 1914. To what figures will the available tonnage of 1899 have increased during the fifteen years ending in 1914? In order to show more clearly the rate at which the tonnage of available traffic was increasing the New Panama Canal Company in 1898 computed the tonnage of traffic that was available in 1888. A study of their figures for those two years shows that the available

canal traffic had increased 25.1 per cent. during that decade. In order to determine whether that rate of increase might properly be accepted, the writer made a study of the rate of growth of traffic of various sections of the world with the United States and Europe.

It was found that the value of the trade between the Atlantic coast of the United States and Pacific South America increased 26.8 per cent. during the decade 1889–1899. For the commerce between our Atlantic seaboard and Pacific countries other than South America the growth was 49.7 per cent. The trade of the United States with Australasia more than doubled during the decade ending in 1900. The vessel movements between Europe and Chile increased 33.3 per cent. during the ten years ending in 1898. European entrances from the west coast of South America gained 36.5 per cent. While the trade between the Pacific Coast of the United States and trans-Pacific countries will not use the canal, the rate at which that commerce is increasing may well be considered in this connection. The total entrances and clearances of the trade between our Pacific Coast and Hawaii, Siberia, Japan, China, and Hong Kong gained 191 per cent. from 1889 to 1899.

It was evident that a rate of 25.1 per cent. per decade might be taken as a very conservative estimate of the growth in the tonnage of available canal traffic between 1899 and 1914. An increase of 25.1 per cent. per decade would raise the tonnage of 1899 to approximately 7,000,000 tons for 1914; and a traffic of that amount may safely be predicted for the early years of the operation of the canal.

The rate at which the traffic of the canal will increase after the waterway has been put in operation must be a matter of conjecture. But it will be interesting to inquire what the prospects are. One naturally turns to the Suez Canal for the purpose of comparison; but the history of the traffic of that waterway can hardly be repeated in the case of the Panama Canal route. The Suez Canal was opened in 1869, and there was a very moderate growth of traffic for about five years. The total net tonnage for the first five years amounted to only 5,358,237 vessel tons. The slow increase during the first few years was due to the fact that the Suez Canal could be used only by steamers, and in 1870 there was but a small number of steamers available for the commerce of Europe with the East Indies. Steamers had to be constructed and substituted for sailing vessels before the Suez route could be adopted in place of the course around the Cape of Good Hope for any considerable volume of traffic. After the substitution had

been made the rate of increase in tonnage was rapid. During the third five-year period the traffic was 217 per cent. of that of the second five-year period. During the fourth five-year period the traffic was 286 per cent. of that of the second five-year period, and during the sixth quinquennial period—1895–1899—the tonnage was 401 per cent. of the traffic during the years 1875–1879. During the last quinquennial period of the twenty-five years from 1875 to 1899 the traffic of the Suez Canal was four times that of the first five years of that period. During the second decade of the operation of the Suez Canal—that is, from 1880 to 1890—there was an increase of 125 per cent. tonnage over the previous decade.

If it be assumed that the tonnage of the American canal during the first ten years of its operation will increase only one-half as fast as the traffic of the Suez Canal did during the second decade of its existence, the rate of growth predicted for the Panama Canal will be 62½ per cent. An increase of 62½ per cent. in the estimated figures for 1914—approximately, 7,000,000 tons—would give a tonnage of about 11,250,000 for the year 1954. It would be difficult to conceive of a more conservative estimate than this, and yet it shows a relatively large prospective traffic for the American canal at the the close of the first ten years. The figures for the American canal for 1924 are about the same as those for the present tonnage of the Suez Canal. The traffic of the Suez waterway in 1914 will probably be at least one and one-half times its present amount.

THE EXPLORATIONS OF THE RUSSIAN HYDROGRAPHIC EXPEDITION IN THE ARCTIC OCEAN IN 1902.*

The Russian Hydrographic Commission reports, concerning the fifth season of field work in the Arctic Ocean during the summer of 1902, that important progress was made in the survey of the coast-line and in the sounding and survey of the Kara Sea and of the shoals on the White Sea. Much material was obtained for the correction of the very imperfect existing charts of the region. During the frequent interruptions of survey work, on account of the ice, meteorologic, magnetic, tidal, and current observations were made, and dredging was done for the collection of material

* Condensed from Annalen d. Hydr. u. Marit. Meteorologie, 1903, Heft XI, p. 492.

for the study of the fauna and the flora of the Arctic. The expedition consisted of two Archangel steamers, the *Pachtusoff* and the *Lieutenant Oftsyn*, of which the latter took part only in the work in the northern part of the White Sea. The leader of the expedition, Captain A. Warnek, was upon the *Pachtusoff*. The late spring and the consequent position of the ice did not permit the ships to leave Archangel until 7/20 June.

The first task of the season was the survey of the Orloff shoals—a difficult matter, because they are narrow, and some are only about a mile in length. The dangerous western boundary of the shoals was found to be 2½ nautical miles nearer the coast than was indicated on the charts. The least depth of water on the shoals was determined as 4 feet, instead of 12 feet, as indicated on the charts. Seven fathoms was the least depth noted in the channel between the shoals and the coast, and the whole bottom was found to be incorrectly given on the charts. The average temperature of the air from 8/24 June to 21 June/7 July was +2.1°C, with a minimum of −0.5° C. on 14/27 June, and a maximum of +6.9° C. on 22 June/5 July. Snow fell five times. At the Orloff lighthouse, on the coast, the extremes were somewhat greater. The tide interval, as determined at the Orloff lighthouse, is about 10 hours 21 minutes. Spring tide rises 19 feet 6 inches, neap tide 10 feet 4 inches, but these values are greatly affected by the wind. The strongest current was found on the Gorjainoff Bank, where it amounts to 3½ nautical miles per hour, toward S. W. during flood, and toward N. E. during ebb. The wind had little effect upon either direction or velocity of the currents.

After finishing the work upon the Orloff banks, the ships returned to Archangel for supplies, and on 3/16 July the *Pachtusoff* started alone for the mouth of the Petchora River. The attempt to pass north of Kolgujeff Island was unsuccessful on account of ice, and the ship had to turn back and take the southern route.

A survey of the coast of the Russian Cape (Russky Saworot) peninsula was made. The position of the extremity of the Cape was found to be 68° 58¾′ N., 54° 35′ E., 3½ minutes farther east, and ¾ minute south of the position given on the old charts. Shoals are lacking from the north shore of the peninsula, and the 5-fathom line is about half a mile from the coast. Unusually warm weather prevailed, the average temperature on 8 July being + 16.5° C. in air and + 15° C. in the ocean. Within the Petchora estuary the water was considerably warmer (+19.5° C. near Nikitsa on 20 July/2 August).

The *Pachtusoff* left the Petchora River on 26 July/8 August, and proceeded to the Kara Strait, where a surveying party was left on Waigatch Island. After two unsuccessful attempts to enter the Kara Sea—great quantities of ice still blocking the way—the steamer explored the the northwest side of Waigatch and discovered an anchorage which is protected from all winds and from moving ice. This is the only anchorage in the region, and it is of particular importance to ships making for Nova Zembla. Coal ships could winter here comfortably, there being plenty of fresh water upon Waigatch near at hand, and there being no danger of crushing by the ice. The value of "Pachtusoff Roadstead," as it was christened, is increased by its entrance being from the Arctic Ocean, and not from the Kara Sea. It is easy to find and to enter, and the expedition set beacons along the proper channel.

On 16/29 August the steamer went to the Yugor Strait to begin the survey of the southwest coast of the Kara Sea. Fifty years had elapsed since the last preceding Russian surveys were made along this coast. The *Pachtusoff* was weather-bound for several days in a protected bay, which Captain Warnek discovered in 1900 in the southwest part of Waigatch Island, and the survey work was brought to an end on 25 August/7 September by the closing of the season. Another good anchorage was discovered in the strait between Mjestny Island and the coast. Soundings decrease gradually from 18 to 20 fathoms near Mjestny Island to 7 fathoms near the mouth of the Kara River. From the mouth of the Kara the depth of the water increases regularly to a point 18 nautical miles E. N. E. from Mjestny Island, where 95 fathoms was found. The depth of the Kara Sea has been greatly exaggerated. At the spot where Russian Admiralty chart No. 432 shows the maximum sounding as 406 fathoms the present survey found but 100 fathoms, and the deepest portion measured in 1902 gave but 120 fathoms. The salt content of the water of the southern part of Kara Sea is rather high, and it decreases very little on going toward the Baidaratskaia Bay, from 1.0250 at the Yugor Strait to 1.0185 near the mouth of the Kara. The temperature of the water likewise increased in the same direction.

In Kara Strait the expedition found very uneven bottom, with remarkably rapid changes in the soundings. At one time 9 minutes of slow steaming brought the ship from a sounding of 65 fathoms to one of 5½ fathoms. Both ends of the strait show deep water—80 fathoms at the west end, 60 fathoms at the east end—with much shallower water in the middle. Upon the submerged ridge, which

extends from Waigatch Island toward Nova Zembla, the maximum sounding was determined at 25 fathoms, but nothing of 20 fathoms or less was found.

The following magnetic observations were among those made by the expedition:

Orloff lighthouse, 7.30 P.M., 11/24 June.........	Decl., 8° 18.4′ E.
Russian Cape (Russky Saworot) Penin., 8 P.M., 8/21 July................................	" 16° 8.8′ E.
Northwest coast of Waigatch Island, 10 A.M., 28 July/10 August........................	" 18° 47.8′ E.
Near the mouth of the Kara River, 10 A.M., 25° August/7 September...................	" 19° 33.5′ E.

E. O. H.

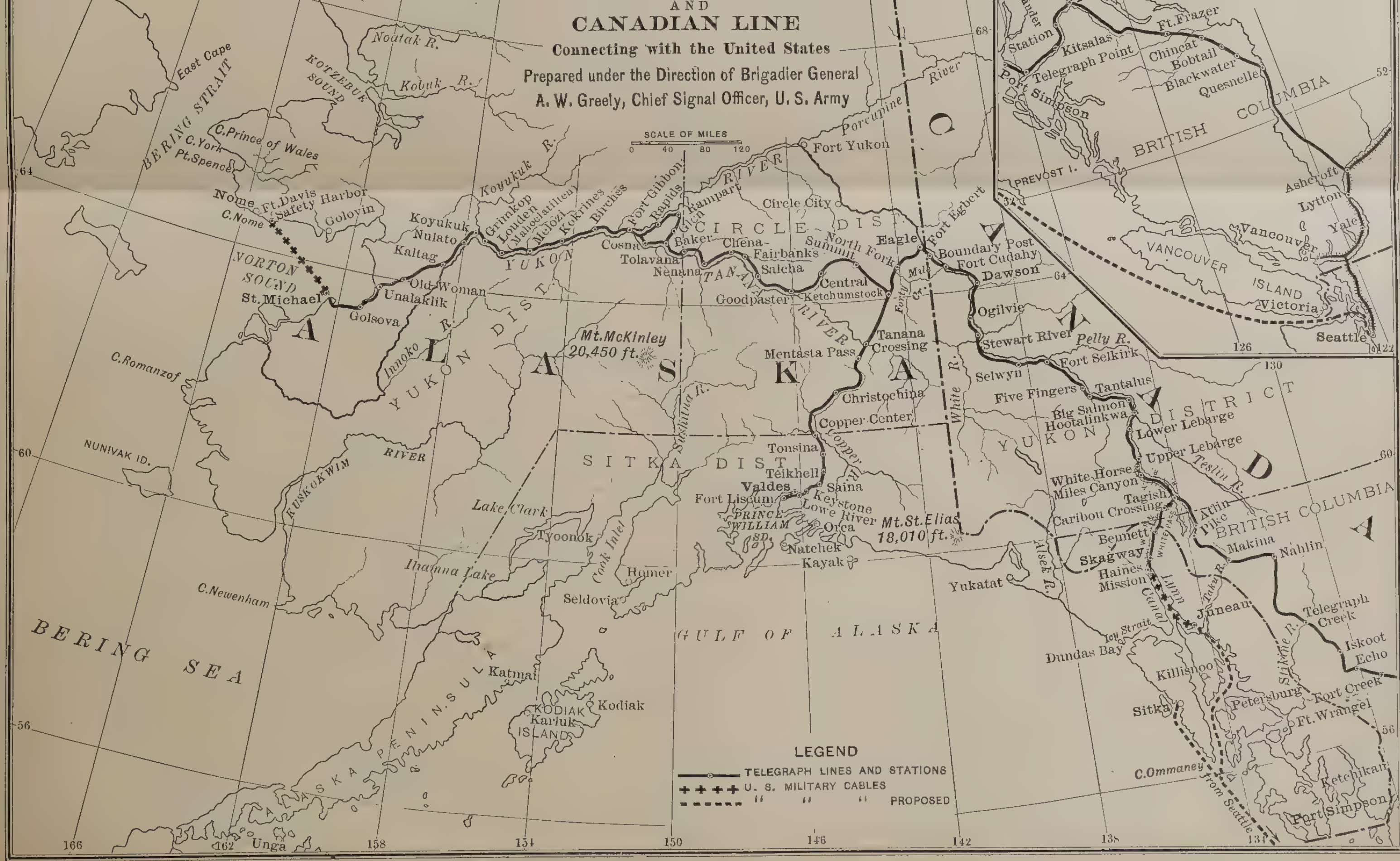
ALASKAN CABLES AND TELEGRAPHS.

The accompanying map is reduced from the new War Department map showing the completed cable lines in Alaskan waters, those that are proposed and are to be carried out next year, the telegraph lines now in operation in the Territory, and the British Columbia land line from Ashcroft, on the Canadian Pacific R.R., to Dawson and Eagle.

It is expected that the cable from Seattle to Sitka and Juneau will be laid in April next. The cable, 1,300 miles in length, was manufactured near New York City after Congress had authorized the line on March 3, 1903, and was delivered at San Francisco in the fall. The route from Seattle to Sitka was surveyed by Capt. J. F. Pratt, of the Coast and Geodetic Survey.

The cable route passes from Puget Sound out into the Pacific to the west of Vancouver Island and the Queen Charlotte Islands, and then makes straight for the south end of Baranov Island, on which Sitka is situated. At the south end of this island one branch will be laid north to Sitka and the other northeast through the coastal channels to Juneau.

The map shows that two cable lines in Alaskan waters have already been completed. One of them extends from Juneau up Lynn Canal to Skagway; the other connects St. Michael with Nome, the centre of the largest placer gold-mining industry in


AND
CANADIAN LINE
Connecting with the United States
Prepared under the Direction of Brigadier General
A. W. Greely, Chief Signal Officer, U. S. Army
SCALE OF MILES
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LEGEND
TELEGRAPH LINES AND STATIONS
U. S. MILITARY CABLES
" " " PROPOSED
BERING SEA
BERING STRAIT
GULF OF ALASKA
ALASKA
CANADA
SITKA DIST.
YUKON DIST.
CIRCLE DIST.
YUKON DISTRICT
BRITISH COLUMBIA
VANCOUVER ISLAND
Mt. McKinley 20,450 ft.
Mt. St. Elias 18,010 ft.
Nome
St. Michael
Fort Gibbon
Fort Yukon
Circle City
Eagle
Fort Egbert
Dawson
Valdes
Skagway
Juneau
Sitka
Seattle

Alaska. Unfortunately, the cable between St. Michael and Nome has been broken by ice in the shallow waters of Norton Sound, and the break is not yet repaired. Thus Nome, a town of 25,000 inhabitants, is now isolated, and will be till navigation opens about June 1 next.

The Signal Corps has built 1,740 miles of land lines, and we are already in electric communication with various districts of the Territory. Despatches, for example, may be sent from Juneau by the Lynn Canal cable to Skagway, and thence by the land line toward the Yukon River, to be transferred to the British Columbia telegraph and the United States; or they may be sent from Valdes, on Prince William Sound, the port for the Copper River mines, by the line we have completed to Eagle, on the Yukon, and thence up the Yukon to Dawson, British Columbia, and the United States; or they may be sent from St. Michael up the Yukon and Tanana Rivers to Eagle and there forwarded by the Canadian lines. The numerous telegraph stations scattered along these lines are indicated on the map.

Most of our mining centres in Alaska are now provided with telegraph facilities. The chief exceptions are the great placer-mining region of the Seward Peninsula, of which Nome is the main point; and the mining camps of Cook Inlet and of the interior region around Circle City and the northern bend of the Yukon.

These land lines have been constructed under great difficulties, and the Signal Corps is entitled to unstinted praise for its arduous and successful labours. The winter months were found to be the best working season, though the mean temperature is below zero and the snow is deep. Practically no wagon roads exist in the country traversed, and the material had to be sledded into the interior in midwinter or carried by pack animals over the roughest imaginable trails. Many hardships might have been escaped if it had not been found that the cold and snow of winter are less unfavourable for building telegraph lines than are the morasses and fires of summer. The importance of the telegraph system will rapidly increase as the increasing number of miners enlarges business interests.

REPORT OF R. E. PEARY, C.E., U.S.N., ON WORK DONE IN THE ARCTIC IN 1898–1902.*

Mr. President, and
Members of the Peary Arctic Club:

In January, 1897, I promulgated before the American Geographical Society, of New York City, my plan for an extended scheme of Arctic exploration, having for its main purpose the attainment of the North Pole. During the spring of 1897, your President, Morris K. Jesup, became interested in the matter, and suggested the idea of the present Club. His example was followed by other prominent men, and late in May, through the persistent personal efforts of Chas. A. Moore, backed by letters from these and other influential men, five years leave of absence was granted me by the Navy Department, to enable me to carry out my plans.

It being too late that season to get the main expedition under way, the summer of 1897 was devoted to a preliminary trip to the Whale Sound region, to acquaint the Eskimos with my plan for the coming year, and set them to work laying in a stock of skins and meat. These objects were successfully accomplished, and in addition the great "Ahnighito" meteorite of Melville Bay, the largest known meteorite in the world, was brought home.

In December, 1897, while I was in London, the steam yacht *Windward*, which had been used in his Franz Josef Land expedition, was tendered to me by Alfred Harmsworth, who offered to have her re-engined and delivered to me in New York. This generous offer I accepted.

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* THE PEARY ARCTIC CLUB OF NEW YORK CITY,
NEW YORK, Oct. 15, 1903.

SIR:

We enclose herewith, for such consideration and action as your Society may deem advisable, copy of the report, with accompanying maps and photographs of Commander Peary, U.S.N., on the work which has been done under the auspices of this Club during the years 1898–1902.

We have the honor to be,
Yours very respectfully,
MORRIS K. JESUP,
President.
H. L. BRIDGMAN,
Secretary.

THE SECRETARY
American Geographical Society,
New York.

In the spring of 1898 the Peary Arctic Club was organized, Morris K. Jesup, Henry W. Cannon, H. L. Bridgman, all personal friends of mine, forming the nucleus about which the rest of you assembled, and in May the *Windward* arrived; but, to my regret and disappointment, the machinists' strike in England having prevented the installation of new engines, she was practically nothing but a sailing craft.

The lateness of the season was such that I had to make the most of the *Windward* as she was. But her extreme slowness (3½ knots under favorable circumstances), and the introduction of a disturbing factor in the appropriation by another of my plan and field of work, necessitated the charter of an auxiliary ship if I did not wish to be distanced. The *Windward* sailed from New York on the 4th of July, 1898, and on the 7th I went on board the *Hope* at Sydney, C. B.

1898–1899.

Pushing rapidly northward, and omitting the usual calls at the Danish Greenland ports, Cape York was reached after a voyage, uneventful except for a nip in the ice of Melville Bay, which lifted the *Hope* bodily, and for a few hours seemed to contain possibilities of trouble.

The work of hunting walrus and assembling my party of natives was commenced at once, the *Windward* soon joined us, after which the hunting was prosecuted by both ships until the final rendezvous at Etah, whence both ships steamed out on Saturday, August 13th, the *Windward* to continue northward, the *Hope* bound for home. The *Windward* was four hours forcing her way through a narrow barrier of heavy ice across the mouth of Foulke Fjord. Here the *Hope* left us, straightening away southward toward Cape Alexander, and the *Windward* headed for Cape Hawkes, showing distinctly beyond Cape Sabine.

At four A. M. Sunday we encountered scattered ice off Cape Albert. About noon we were caught in the ice near Victoria Head, and drifted back several miles. Finally we got round Victoria Head into Princess Marie Bay at six P. M. The bay was filled with the season's ice, not yet broken out, while Kane Basin was crowded with the heavy, moving polar pack. Between the two, extending northward across the mouth of the bay, was a series of small pools and threads of water, opening and closing with the movements of the tide. At 11.30 P. M. of the 18th the *Windward* had worried her way across the bay to a little patch of open water close under

Cape D'Urville. Here further progress was stopped by a large floe, several miles across, one end resting against the shore, the other extending into the heavy ice. While crossing the bay the more important stores had been stowed on the deck in readiness to be thrown out upon the ice in the event of a nip. Pending the turning of the tide, when I hoped the big floe would move and let us proceed, I landed at Cape D'Urville, deposited a small cache of supplies and climbed the bluffs to look at the conditions northward.

August 21, I went on a reconnoissance along the ice-foot to the

CAPE ALBERT.

head of Allman Bay and into the valley beyond. The night of the 21st young ice formed, which did not melt again. On the 28th I attempted to sledge over the sea-ice to Norman Lockyer Island, but found too many weak places, and fell back on the ice-foot. The night of the 29th the temperature fell to 13° F., and on the 31st the new ice was four and a quarter inches thick. On this day I went to Cape Hawkes and climbed to its summit, whence I could see lakes out in Kane Basin, but between them and the *Windward* the ice was closely packed—a discouraging outlook. Only a strong and continued westerly wind would give me any chance. I could

not leave the ship for fear an opportunity to advance would occur in my absence.

September 2nd, I started on a sledge trip up Princess Marie Bay. At Cape Harrison the strong tidal current kept the ice broken, so that I could not round it, and the ice-foot was impracticable for sledges. I went on foot to the entrance of Cope's Bay, surveying the shore to that point, and returned to the ship after four days. During this trip I obtained the English record from the cairn on the summit of Norman Lockyer Island, deposited there twenty-two years ago. This record was as fresh as when left.

September 6th, I left the ship to reconnoitre Dobbin Bay, the head of which is uncharted, returning three days later. During this trip the first real snowstorm of the season occurred, five and a half inches falling.

September 12th, one-third of my provisions, an ample year's supply for the entire party, was landed at Cape D'Urville, my Eskimos sledging loads of 700 to 1,000 pounds over the young ice. The night of the 13th the temperature dropped to $-10°$ F., and all hope of further advance was at an end. September 15th the boiler was blown off and preparations for winter commenced.

On the 17th I broached my plans for the winter campaign, as follows:

The autumn work was simple enough and outlined itself. It comprised two items: the securing of a winter's supply of fresh meat and the survey of the Buchanan Strait–Hayes Sound–Princess Marie Bay region. In spite of the peculiarly desolate character of that part of the Grinnell Land coast immediately about the *Windward*, and the apparent utter absence of animal life, I felt confident of accomplishing the former. Various reconnoissances thus far, on the north shore of Princess Marie Bay, had given me little encouragement, but I knew that the Eskimos had killed one or two musk oxen, in years past, on Bache Island, and that region looked favorable for them. As regarded the survey, a presentiment that I must begin it at the earliest moment had led me to make attempts to reach the head of Princess Marie Bay.

As to the spring campaign, I proposed to utilize the winter moons in pushing supplies to Fort Conger, to move my party to that station early in February, and on the return of the sun start from there as a base and make my attempt on the Pole *via* Cape Hecla. I *might* succeed in spite of the low latitude of my starting-point, and, in any event, could reach the ship again before the ice broke

up, with thorough knowledge of the coast and conditions to the north.

September 18th, I left the ship with two sledges and my two best Eskimos, with provisions for twelve days, for a reconnoissance of Princess Marie Bay. September 20th I reached the head of a small fjord running southwest from near the head of Princess Marie Bay, and found a narrow neck of land, about three miles wide, separating it from a branch of Buchanan "Strait." Bache "Island" of the chart is, therefore, a peninsula and not an island. From a commanding peak in the neighbourhood I could see that both arms of Buchanan "Strait" ended about south of my position; that the "Strait" is in reality a bay, and that Hayes Sound does not exist. On the 21st and 22nd I penetrated the arms of Princess Marie Bay, designated as Sawyer and Woodward Bays on the charts, and demonstrated them to be entirely closed.

September 23rd, while entering a little bight about midway of the north shore of Bache Peninsula, I came upon two bears. These my dogs chased ashore and held at bay until I could come up and kill them.

September 25th, I crossed Bache Peninsula on foot with my two men, from Bear Camp to the intersection of the northern and southern arms of Buchanan Bay. Here we found numerous walrus, and could command the southern arm to the large glacier at its head. Comparatively recent musk-ox tracks convinced me of the presence of musk-oxen on the peninsula. The next day I returned to the *Windward* to refit and start for Buchanan Bay *via* Victoria Head and Cape Albert in the quest of walrus and musk-oxen. Henson, in a reconnoissance northward during my absence, had been unable to get more than a few miles beyond Cape Louis Napoleon, the sea ice and the ice-foot being alike impracticable. A day or two after my return I started him off again to try it.

September 30th, I started for Buchanan Bay. Between Victoria Head and Cape Albert I found fresh tracks of a herd of musk-oxen, and followed them until obliterated by the wind. The walrus grounds in Buchanan Bay were reached late on October 4th, and the next day I secured a walrus and the remainder of my party arrived. The following day every one was out after musk-oxen; but, finding it very foggy on the uplands of the peninsula, I returned to camp and went up to Buchanan Bay in search of bears. While I was away one of my hunters killed a bull musk-ox.

On the 7th I sent two men to bring the meat and skin, while I went up Buchanan Bay again. Returning to camp, I found it

deserted. A little later some of the party returned, reporting a herd of fifteen musk-oxen killed. The next two days were consumed in cutting up the animals, stacking the meat and getting the skins and some of the meat out to camp.

October 10th, we started for the ship, which was reached late on the 12th. The ice in Buchanan Bay was very rough, and a snow-storm on the 11th made going very heavy. Five days later, October 17th, I went with two men to locate a direct trail for getting the meat out to the north side of the peninsula, but found the country impracticable, and returned to the ship on the 21st. The sun left us on the 20th.

The following week was devoted to the work of preparation for the winter. A reconnoissance of Franklin Pierce Bay developed nothing but hare tracks, but Henson came in from Cope's Bay with a big bear, killed near the head of the Bay. This marked the end of the fall campaign, with our winter's fresh meat supply assured and the Bache "Island"–Buchanan "Strait"–"Hayes Sound" question settled.

The next step was the inauguration of the teaming work, which was to occupy us through the winter. I already had my pemmican and some miscellaneous supplies at Cape Louis Napoleon, and two sledge loads of provisions at Cape Fraser. The rapidly-disappearing daylight being now too limited for effective travelling, I was obliged to await the appearance of the next moon before starting for a personal reconnoissance of the coast northward. On the 29th I left the ship with Henson and one Eskimo. The soft snow of the last two storms compelled me to break a road for the sledges with snow-shoes across Allman Bay and along many portions of the ice-foot, but in spite of this delay we camped at Cape Louis Napoleon after a long march.

The next day we reached Cape Fraser, having been impeded by the tide rising over the foot ice, and camped at Henson's farthest, at the beginning of what seemed an impracticable ice-foot. It was the only possible way of advance, however, as the still-moving pack in the channel was entirely impassable. The following day I made a reconnoissance on foot as far as Scoresby Bay, and though the ice-foot was then impracticable for sledges, I was convinced that a good deal of earnest work with picks and shovels, assisted by the levelling effects of the next spring tides, would enable me to get loaded sledges over it during the next moon. From Cape Norton Shaw I could see that by making a detour into Scoresby Bay the heavy pack could be avoided in crossing.

This stretch of ice-foot from Cape Fraser to Cape Norton Shaw is extremely Alpine in character, being an almost continuous succession of huge blocks and masses of bergs and old floes, forced bodily out of the water and up on to the rocks. At Cape John Barrow a large berg had been forced up on the solid rock of the cape, until one huge fragment lay fully one hundred feet above the high-tide level.

Returning from my reconnoissance, I camped again at Cape Fraser, building the first of the snow igloos, which I intended should be constructed at convenient intervals the entire distance

CAPE LOUIS NAPOLEON.

to Fort Conger. The next three days were occupied in bringing the supplies at Cape Louis Napoleon up to Cape Fraser, and on the 4th of November I returned to the ship.

The time until the return of the next moon was fully occupied in making and repairing sledges, bringing in beef from the cache on Bache Peninsula, and transporting supplies and dog-food to Cape Hawkes, beyond the heavy going of Allman Bay. During much of this time the temperature was in the 40°s Fahr.

November 21, Henson and three Eskimos left with loads, and on the 22nd I followed with a party of three to begin the work of the

November moon. This work ended just after midnight of December 4, when the last sledges came in. It left 3,300 pounds of supplies and a quantity of dog-food at Cape Wilkes, on the north side of Richardson Bay. These supplies would have been left at Cape Lawrence had it not been for the desertion and turning back of one of my men, discouraged with the hard work, while crossing Richardson Bay. Knowing it to be essential to prevent any recurrence of the kind, I pushed on to Cape Wilkes, camped and turned in after a twenty-five-hour day, slept three hours, then started with empty sledge, eight picked dogs and an Eskimo driver, to overtake my man. He was found at Cape Louis Napoleon, and, after receiving a lesson, was taken along with me to the ship.

My party was left with instructions to bring up supplies which the wrecking of sledges had obliged me to cache at various places, assemble all at Cape Wilkes, and then, if I did not return, reconnoitre the ice-foot to Rawlings Bay, and return to the ship.

The distance from Cape Wilkes to the *Windward* was sixty nautical miles in a straight line (as travelled by me along the ice-foot and across the bays, not less than ninety statute miles); and was covered in 23 hours and 20 minutes, or 21 hours 30 minutes actual travelling time. Temperature during the run, $-50°$ F.

Every sledge was more or less smashed in this two weeks' campaign, and at Cape John Barrow sledges and loads had to be carried on our backs over the ice jams. The mean daily minimum temperature for the thirteen days was $-41.2°$ F., the lowest $-50°$ F., which occurred on four successive days.

The experience gained on this trip led me to believe that the conditions of travel from Cape Wilkes northward as far at least as Cape Defosse would not differ materially from those already encountered, and enabled me to lay my plans with somewhat greater detail. With the light of the December moon I would proceed to Cape Wilkes with such loads as would enable me to travel steadily without double-banking, advance everything to Cape Lawrence on the north side of Rawlings Bay, then go on to Fort Conger with light sledges, determine the condition of the supplies left there that I might know what I could depend upon, and then return to the ship.

In the January moon I would start with my entire party; move supplies from Cape Lawrence to Fort Conger; remain there till the February moon, the light of which would merge into the beginning of the returning daylight; then sledge the supplies for

the polar journey to Cape Hecla, and be in readiness to start from there with rested and well-fed dogs by the middle of March.

In pursuance of this plan, the two weeks intervening between the departure of the November moon and the appearance of the December one were busily occupied in repairing and strengthening sledges, and making and overhauling clothing and equipment, to enable us to meet this long and arduous journey in the very midnight of the "Great Night." During this interval the temperature much of the time was at $-50°$ F. and below.

December 20, in the first light of the returning moon, I left the *Windward* with my doctor, Henson, four Eskimos and thirty dogs, all that were left of the sixty odd of four months previous. Thick weather, strong winds rushing out of Kennedy Channel, heavy snow and an abominable ice-foot in Rawlings Bay delayed us, and it was not until the 28th that I had all my supplies assembled at Cape Lawrence, on the north side of Rawlings Bay.

Cape Lawrence presented the advantage of two possible routes by which these latter supplies could be reached from Conger, one through Kennedy Channel, which I was about to follow, and the other *via* Archer Fjord and overland. In spite of the delays I felt, on the whole, well satisfied with the work up to the end of the year. I had all my supplies half way to Fort Conger, and had comfortable snow igloos erected at Cape Hawkes, Cape Louis Napoleon, Cape Fraser, Cape Norton Shaw, Cape Wilkes, and Cape Lawrence.

December 29, I started from Cape Lawrence with light sledges for Fort Conger, hoping to make the distance in five days. The first march from Cape Lawrence the ice-foot was fairly good, though an inch or two of efflorescence made the sledges drag as if on sand. The ice-foot grew steadily worse as we advanced, until, after rounding Cape Defosse, it was almost impassable, even for light sledges. The light of the moon lasted only for a few hours out of the twenty-four, and at its best was not sufficient to permit us to select a route on the sea ice.

Just south of Cape Defosse we ate the last of our biscuit, just north of it the last of our beans. On the next march a biting wind swept down the Channel and numbed the Eskimo, who had spent the previous winter in the United States, to such an extent, that, to save him, we were obliged to halt just above Cape Cracroft and dig a burrow in a snowdrift. When the storm ceased, I left him with another Eskimo and nine of the poorer dogs, and pushed on to reach Fort Conger.

The moon had left us entirely now, and the ice-foot was utterly

impracticable, and we groped and stumbled through the rugged sea ice as far as Cape Baird. Here we slept a few hours in a burrow in the snow, then started across Lady Franklin Bay. In complete darkness and over a chaos of broken and heaved-up ice, we stumbled and fell and groped for eighteen hours, till we climbed upon the ice-foot of the north side. Here a dog was killed for food.

Absence of suitable snow put an igloo out of the question, and a semi-cave under a large cake of ice was so cold that we could stop only long enough to make tea. Here I left a broken sledge and nine exhausted dogs. Just east of us a floe had been driven ashore, and forced up over the ice-foot till its shattered fragments lay a hundred feet up the talus of the bluff. It seemed impassable, but the crack at the edge of the ice-foot allowed us to squeeze through; and soon after we rounded the point, and I was satisfied by the "feel" of the shore, for we could see nothing, that we were at one of the entrances of Discovery Harbor, but which, I could not tell.

Several hours of groping showed that it was the eastern entrance. We had struck the centre of Bellot Island, and at midnight of January 6 we were stumbling through the dilapidated door of Fort Conger. A little remaining oil enabled me, by the light of our sledge cooker, to find the range and the stove in the officers' quarters, and, after some difficulty, fires were started in both. When this was accomplished, a suspicious "wooden" feeling in the right foot led me to have my kamiks pulled off, and I found, to my annoyance, that both feet were frosted.

Coffee from an open tin in the kitchen, and biscuit from the table in the men's room, just as they had been dropped over fifteen years ago, furnished the menu for a simple but abundant lunch. A hasty search failing to discover matches, candles, lamps or oil, we were forced to devise some kind of a light very quickly, before our oil burned out. Half a bottle of olive oil, a saucer and a bit of towel furnished the material for a small native lamp, and this, supplemented by pork fat and lard, furnished us light for several days, until oil was located. Throwing ourselves down on the cots in the officers' rooms, after everything had been done for my feet, we slept long and soundly. Awakening, it was evident that I should lose parts or all of several toes, and be confined for some weeks. The mean minimum temperature during the trip was 51.9° F., the lowest 63° F.

During the following weeks our life at Conger was pronouncedly *à la* Robinson Crusoe. Searching for things in the unbroken dark-

ness of the "Great Night," with a tiny flicker of flame in a saucer, was very like seeking a needle in a haystack. Gradually all the essentials were located, while my two faithful Eskimos brought in empty boxes and barrels and broke them up to feed the fire. The dogs left on Bellot Island were brought in, but several died before they got used to the frozen salt pork and beef, which was all I had to feed them. The natives made two attempts to reach and bring in the two men left at Cape Cracroft, but were driven back both times by the darkness and furious winds. Finally, some ten days after we left the dug-out, they reached it again, and found that the two men, after eating some of their dogs, had started for the ship on foot, the few remaining dogs following them.

On the 18th of February, the moonlight and the remaining twilight afforded enough light for a fair day's march in each twenty-four hours; we started for the *Windward*. My toes were unhealed, and I could hardly stand for a moment. I had twelve dogs left, but their emaciated condition and the character of the road precluded riding by any one but myself. Lashed firmly down, with feet and legs wrapped in musk-ox skin, I formed the only load of one sledge. The other carried the necessary provisions.

On the 28th we reached the *Windward*, everyone but myself having walked the entire distance, of not less than 250 miles, in eleven days. Fortunately for us, and particularly for me, the weather during our return, though extremely cold, was calm, with the exception of one day from Cape Cracroft south, during which the furious wind kept us enveloped in driving snow. The mean minimum daily temperature while we were returning was $-56.18°$ F., reaching the lowest, $-65°$ F., the day we arrived at the *Windward*.

March 3. I started one of my Eskimos for Whale Sound with a summons to the hunters there to come to me with their dogs and sledges. Between the 3rd and the 14th, a party of Eskimos coming unexpectedly, the last of the musk-ox meat on Bache Peninsula was brought to the ship, and another bull musk-ox killed.

March 13. The final amputation of my toes was performed. Pending the arrival of more natives, I sent a dory to Cape Louis Napoleon to be cached, and had dog-food and current supplies advanced to Cape Fraser.

March 31, a contingent of five natives and twenty-seven dogs came in. My messenger had been delayed by heavy winds and

rough ice, and the ravages of the dog disease had made it necessary to send to the more southerly settlements for dogs.

April 3, Henson left with these natives and thirty-five dogs, with instructions to move the supplies at Cape Lawrence to Carl Ritter Bay, then push on with such loads as he could carry without double-banking to Fort Conger, rest his dogs and dry his clothing, and if I did not join him by that time to start back.

April 19, my left foot had healed, though it was still too weak and stiff from long disuse for me to move without crutches. On this day I started for Fort Conger with a party of ten, some fifty dogs, and seven sledges, loaded with dog-food and supplies for return caches.

April 23, I met Henson returning with his party at Cape Lawrence. From there I sent back my temporary help and borrowed dogs, and went on with a party of seven, including five natives. April 28 we reached Conger.

May 4. Having dried all our gear and repaired sledges, I started for a reconnoissance of the Greenland northwest coast. I should have started two days earlier but for bad weather. Following the very arduous ice-foot to St. Patrick's Bay, I found the bay filled with broken pack ice covered with snow almost thigh deep. From the top of Cape Murchison, with a good glass, no practicable road could be seen. The following day I sent two men with empty sledges and a powerful team of dogs to Cape Beechey, to reconnoitre from its summit. Their report was discouraging. Clear across to the Greenland shore, and up and down as far as the glass could reach, the channel was filled with upheaved floe fragments, uninterrupted by young ice or large floes, and covered with deep snow.

Crippled as I was, and a mere dead weight on the sledge, I felt that the road was impracticable. Had I been fit and in my usual place, ahead of the sledges breaking the ice with my snow-shoes, it would have been different. One chance remained—that of finding a passage across to the Greenland side at Cape Lieber.

Returning to Fort Conger, I sent Henson and one Eskimo off immediately on this reconnoissance, and later sent two men to Musk Ox Bay to look for musk-oxen. Two days afterward they returned reporting sixteen musk-oxen killed, and Henson came in on the same day, reporting the condition of the channel off Capes Lieber and Cracroft the same as that off Capes Beechey and Murchison, and that they had been unable to get across. I now gave up the Greenland trip, and perhaps it was well that I did so,

as the unhealed place on my right foot was beginning to break down and assume an unhealthy appearance from its severe treatment. As soon as the musk-ox skins and beef were brought in, the entire party, except myself and one Eskimo, went to the Bellows and Black Rock Vale for more musk oxen. Twelve were killed there, and the skins and meat brought to Conger.

Not believing it desirable to kill more musk-oxen, and unable to do any travelling north, I completed the work of securing the meat and skins obtained; getting the records and private papers of the United States Lady Franklin Bay Expedition together; securing as far as possible collections and property; housing material and supplies still remaining serviceable, and making the house more comfortable for the purposes of my party.

May 23. We started for the ship, carrying only the scientific records of the expedition, the private papers of its members, and necessary supplies. I was still obliged to ride continuously. Favored with abundant light and continuously calm weather, and forcing the dogs to their best, the return to the ship was accomplished in six days, arriving there May 29.

During my absence Capt. Bartlett had built at Cape D'Urville, from plans which I furnished him, a comfortable house of the boxes of supplies, double-roofed with canvas, and banked in with gravel.

June 1, I sent one sledge-load of provisions to Cape Louis Napoleon, and four to Cape Norton Shaw. June 6, I sent three loads to Carl Ritter Bay, and two to Cape Lawrence. On the 25th of June, the last of these sledges returned to the *Windward*, and the year's campaign to the north was ended. The return from Carl Ritter Bay had been slow, owing to the abundance of water on the ice-foot and the sea ice of the bays, and the resulting sore feet of the dogs.

June 28, a sufficient number of dogs had recovered from the effect of their work to enable me to make up two teams, and Henson was sent with these, four of the natives and a dory, to make his way to Etah and communicate with the summer ship immediately on her arrival, so that her time would not be wasted even should the *Windward* be late in getting out of the ice.

June 29, I started with two sledges and three natives to complete my survey of Princess Marie and Buchanan Bays, and make a reconnoissance to the westward from the head of the former. My feet, which I had been favoring since my return from Conger, were now in fair condition, only a very small place on the right one remaining unhealed. Travelling and working at night, and sleeping

during the day, I advanced to Princess Marie Bay, crossed the narrow neck of Bache Peninsula, and camped on the morning of July 4th near the head of the northern arm of Buchanan Bay. Hardly was the tent set up when a bear was seen out in the bay, and we immediately went in pursuit, and in a short time had him killed. He proved to be a fine large specimen.

While after the bear, I noticed a herd of musk-oxen a few miles up the valley, and after the bear had been brought into camp and skinned, and we had snatched a few hours' sleep, we went after the musk-oxen. Eight of these were secured, including two fine bulls and two live calves, the latter following us back to camp of their own accord. The next three days were occupied in getting the beef to camp. I then crossed to the southern arm of Buchanan Bay, securing another musk-ox. Returning to Princess Marie Bay, I camped on the morning of the 14th at the glacier, which fills the head of Sawyer Bay.

During the following six days I ascended the glacier, crossed the ice cap to its western side, and, from elevations of from 4,000 to 4,700 feet, looked down upon the snow-free western side of Ellesmere Land, and out into an ice-free fjord, extending some fifty miles to the northwest. The season here was at least a month earlier than on the east side, and the general appearance of the country reminded me of the Whale Sound region of Greenland. Clear weather for part of one day enabled me to take a series of angles, then fog and rain and snow settled down upon us. Through this I steered by compass back to and down the glacier, camping on the 21st in my camp of the 15th.

The return from here to the ship was somewhat arduous, owing to the rotten condition of the one-year ice, and the deep pools and canals of water on the surface of the old floes. These presented the alternative of making endless detours or wading through water often waist deep. During seven days our clothing, tent, sleeping-gear and food were constantly saturated. The *Windward* was reached on the 28th of July.

In spite of the discomforts and hardships of this trip, incident to the lateness of the season, I felt repaid by its results. In addition to completing the notes requisite for a chart of the Princess Marie-Buchanan Bay region, I had been fortunate in crossing the Ellesmere Land ice-cap, and looking upon the western coast. The game secured during this trip comprised 1 polar bear, 7 musk-oxen, 3 oogsook,* and 14 seals.

* Bearded seal.

When I returned to the *Windward* she was round in the eastern side of Franklin Pierce Bay. A party had left two days before with dogs, sledge and boat, in an attempt to meet me and supply provisions. Three days were occupied in communicating with them and getting them and their outfit on board. The *Windward* then moved back to her winter berth at Cape D'Urville, took the dogs on board, and on the morning of Wednesday, August 2, got under way.

During the next five days we advanced some twelve miles, when a southerly wind jammed the ice and drifted us north, abreast of

ETAH, WINTER QUARTERS 1899–1900.

the starting-point. Early Tuesday morning, the 8th, we got another start, and the ice gradually slackening, we kept under way, reached open water a little south of Cape Albert, and arrived at Cape Sabine at 10 P.M.

At Cape Sabine I landed a cache and then steamed over to Etah, arriving at 5 A.M. of the 9th. Here we found mail and learned that the *Diana*, which the Club had sent up to communicate with me, was out after walrus. August 12th the *Diana* returned, and I had the great pleasure of taking Secretary Bridgman, commanding the Club's Expedition, by the hand.

The year had been one of hard and continuous work for the entire party. In that time I obtained the material for an authentic map of the Buchanan Bay-Bache Peninsula-Princess Marie Bay region; crossed the Ellesmere Land Ice-cap to the west side of that land, established a continuous line of caches from Cape Sabine to Fort Conger, containing some fourteen tons of supplies; rescued the original records and private papers of the Greely Expedition; fitted Fort Conger as a base for future work, and familiarized myself and party with the entire region as far north as Cape Beechey.

With the exception of the supplies at Cape D'Urville all the provisions, together with the current supplies and dog-food (the latter an excessive item), had been transported by sledge.

Finally, discouraging as was the accident to my feet, I was satisfied, since my effort to reach the northwest coast of Greenland from Fort Conger in May, that the season was one of extremely unfavorable ice conditions north of Cape Beechey, and I doubt, even if the accident had not occurred, whether I should have found it advisable on reaching Cape Hecla to attempt the last stage of the journey.

My decision not to attempt to winter at Fort Conger was arrived at after careful consideration. Two things controlled this decision: First, the uncertainty of carrying dogs through the winter, and, second, the comparative facility with which the distance from Etah to Fort Conger can be covered with light sledges.

After the rendezvous with the *Diana* I went on board the latter ship and visited all the native settlements, gathering skins and material for clothing and sledge equipment, and recruiting my dog-teams.

The *Windward* was sent walrus-hunting during my absence. The *Diana* also assisted in this work. August 25 the *Windward* sailed for home, followed on the 28th by the *Diana*, after landing me with my party, equipment, and additional supplies at Etah.

The *Diana* seemed to have gathered in and taken with her all the fine weather, leaving us a sequence of clouds, wind, fog, and snow, which continued with scarcely a break for weeks.

After her departure the work before me presented itself as follows: To protect the provisions, construct our winter quarters, then begin building sledges, and grinding walrus meat for dog pemmican for the spring campaign.

During the first month a number of walrus were killed from our boats off the mouth of the fjord; then the usual Arctic winter

settled down upon us, its monotony varied only by the visits of the natives, occasional deer-hunts, and a December sledge journey to the Eskimo settlements in Whale Sound as far as Kangerd-look-soah. In this nine days' trip some 240 miles were covered in six marches, the first and the last marches being of 60 to 70 miles. I returned to Etah just in time to escape a severe snowstorm, which stopped communication between Etah and the other Eskimo settlements completely, until I sent a party with snowshoes and a specially-constructed sledge, carrying no load, and manned by double teams of dogs, to break the trail.

During my absence some of my natives had crossed to Mr. Stein's place at Sabine, and January 9th I began the season's work by starting a few sledge-loads of dog food for Cape Sabine, for use of my teams in the spring journey. From this time on, as the open water in Smith Sound permitted, more dog-food was sent to Sabine, and as the light gradually increased some of my Eskimos were kept constantly at Sonntag Bay, some twenty miles to the south, on the lookout for walrus.

My programme for the spring work was to move three divisions of sledges north as far as Conger, the first to be in charge of Henson; while I brought up the rear with the third.

From Fort Conger I should send back a number of Eskimos; retain some at Conger; and with others proceed north *via* Hecla or the north point of Greenland, as circumstances might determine.

I wanted to start the first division on the 15th of February, the second a week later, and leave with the third March 1st; but a severe storm, breaking up the ice between Etah and Littleton Island, delayed the departure of the first division of seven sledges until the 19th.

The second division of six sledges started on the 26th, and March 4th I left with the rear division of nine sledges. Three marches carried us to Cape Sabine, along the curving northern edge of the north water. Here a northerly gale, with heavy drift, detained me for two days. Three more marches in a temperature of 40° F. brought me to the house at Cape D'Urville. Records here informed me that the first division had been detained here a week by stormy weather, and the second division had left but two days before my arrival. I had scarcely arrived when two of Henson's Eskimos came in from Richardson Bay, where one of them had severely injured his leg by falling under a sledge. One day was spent at D'Urville drying our clothing, and on the 13th

I got away on the trail of the other divisions with seven sledges, the injured man going to Sabine with the supporting party.

I hoped to reach Cape Louis Napoleon on this march, but the going was too heavy, and I was obliged to camp in Dobbin Bay, about five miles short of the cape. The next day I hoped on starting to reach Cape Fraser, but was again disappointed; a severe windstorm compelling me to halt a little south of Hayes Point, and hurriedly build snow igloos in the midst of a blinding drift. All that night and the next day, and the next night, the storm continued. An early start was made on the 16th, and in calm but very thick weather, we pushed on to Cape Fraser. Here we encountered the wind and drift full in our faces, and violent, making our progress from here to Cape Norton Shaw very trying along the ice-foot.

The going from here across Scoresby and Richardson Bays was not worse than the year before; and from Cape Wilkes to Cape Lawrence the same as we had always found it. These two marches were made in clear but bitterly windy weather.

Another severe southerly gale held us prisoners at Cape Lawrence for a day. The 20th was an equally cruel day, with wind still savage in its strength, but the question of food for my dogs gave me no choice but to try to advance. At the end of four hours we were forced to burrow into a snow-bank for shelter, where we remained till the next morning.

In three more marches we reached Cape Leopold von Buch. Two more days of good weather brought us to a point a few miles north of Cape Defosse. Here we were stopped by another furious gale with drifting snow, which prisoned us for two nights and a day.

The wind was still bitter in our faces when we again got under way the morning of the 27th, the ice-foot became worse and worse up to Cape Cracroft, where we were forced down into the narrow tidal joint, at the base of the ice-foot; this path was a very narrow and tortuous one, frequently interrupted, and was extremely trying on men and sledges. Cape Lieber was reached on this march. At this camp the wind blew savagely all night, and in the morning I waited for it to moderate before attempting to cross Lady Franklin Bay. While thus waiting the returning Eskimos of the first and second divisions came in. They brought the very welcome news of the killing of 21 musk-oxen close to Conger. They also reported the wind out in the bay as less severe than at the Cape.

I immediately got under way and reached Conger just before midnight of the 28th—24 days from Etah—during six of which I was held up by storms.

The first division had arrived four days and the second two days earlier. During this journey there had been the usual annoying delays of broken sledges, and I had lost numbers of dogs.

The process of breaking in the tendons and muscles of my feet to their new relations, and the callousing of the amputation scars, in this, the first serious demand upon them, had been disagreeable, but was, I believed, final and complete. I felt that I had no reason to complain.

The herd of musk-oxen so opportunely secured near the station, with the meat cached here the previous spring, furnished the means to feed and rest my dogs. A period of thick weather followed my arrival at Conger, and not until April 2d could I send back the Eskimos of my division.

On leaving Etah I had not decided whether I should go north from Conger *via* Cape Hecla, or take the route along the northwest coast of Greenland. Now I decided upon the latter. The lateness of the season and the condition of the dogs might militate against a very long journey; and if I chose the Hecla route and failed of my utmost aims, the result would be complete failure. If, on the other hand, I chose the Greenland route and found it impossible to proceed northward over the pack, I still had an unknown coast to exploit, and the opportunity of doing valuable work. Later developments showed my decision to be a fortunate one.

I planned to start from Conger the 9th of April, but stormy weather delayed the departure until the 11th, when I got away with seven sledges.

At the first camp beyond Conger my best Eskimo was taken sick, and the following day I brought him back to Conger, leaving the rest of the party to cross the channel to the Greenland side, where I would overtake them. This I did two or three days later, and we began our journey up the northwest Greenland coast. As far as Cape Sumner we had almost continuous road-making through very rough ice. Before reaching Cape Sumner we could see a dark water sky, lying beyond Cape Brevoort, and knew that we should find open water there.

From Cape Sumner to Polaris Boat Camp, in Newman Bay, we cut a continuous road. Here we were stalled until the 21st by continued and severe winds. Getting started again in the tail end of the storm, we advanced as far as the open water, a few miles east of Cape Brevoort, and camped. This open water, about three miles wide at the Greenland end, extended clear across the mouth of Robeson Channel to the Grinnell Land coast, where it reached

from Lincoln Bay to Cape Rawson. Beyond it, to the north and northwest, as far as could be seen, were numerous lanes and pools. The next day was devoted to hewing a trail along the ice-foot to Repulse Harbor, and on the 23d, in a violent gale, accompanied by drift, I pushed on to the "Drift Point" of Beaumont (and later Lockwood), a short distance west of Black Horn Cliffs.

The ice-foot as far as Repulse Harbor, in spite of the road-making of the previous day, was very trying to sledges, dogs, and men. The slippery side slopes, steep ascents and precipitous descents wrenched and strained the men, and capsized, broke, and ripped shoes from the sledges.

I was not surprised to see from the "Drift Point" igloo that the Black Horn Cliffs were fronted by open water. The pack was in motion here, and had only recently been crushing against the ice-foot, where we built our igloo. I thought I had broken my feet in pretty thoroughly on the journey from Etah to Conger; but this day's work of handling a sledge along the ice-foot made me think they had never encountered any serious work before. A blinding snowstorm on the 24th kept us inactive. The next day I made a reconnoissance to the cliffs, and the next set the entire party to work hewing a road along the ice-foot. That night the temperature fell to 25° F., forming a film of young ice upon the water. The next day I moved up close to the cliffs, and then with three Eskimos reconnoitred the young ice. I found that by proceeding with extreme care it would in most places support a man.

With experienced Ahsayoo ahead, constantly testing the ice with his seal spear, myself next, and two Eskimos following, all with feet wide apart, and sliding instead of walking, we crept past the cliffs. Returning we brushed the thin film of newly-fallen snow off the ice with our feet, for a width of some four feet, to give the cold free access to it.

I quote from my diary for the 27th:

> At last we are past the barrier which has been looming before me for the last ten days—the open water at the Black Horn Cliffs. Sent two of my men, whose nerves are disturbed by the prospect ahead, back to Conger. This leaves me with Henson and three Eskimos. My supplies can now be carried on the remaining sledges. Still further stiffened by the continuous low temperature of the previous night, the main sheet of new ice in front of the cliffs was not hazardous, as long as the sledges kept a few hundred feet apart, did not stop, and their drivers kept some yards away to one side. Beyond the limit of my previous day's reconnoissance there were areas of much younger ice, which caused me considerable apprehension, as it buckled to a very disquieting extent beneath dogs and sledges, and, from the motion of the outside pack, was crushed up in places, while narrow cracks opened up in others. Finally, to my relief, we reached the ice-foot beyond the cliffs and camped.

The next day there was a continuous lane of water, 100 feet wide, along the ice-foot by our camp, and the space in front of the cliffs was again open water. We crossed just in time.

Up to Cape Stanton we had to hew a continuous road along the foot-ice. After this the going was much better to Cape Bryant. Off this section of the coast the pack was in constant motion, and an almost continuous lane of water extended along the ice-foot. A long search at Cape Bryant finally discovered the remains of Lockwood's cache and cairn, which had been scattered by bears. Three marches, mostly in thick weather, and over alternating hummocky blue ice and areas of deep snow, brought us at 1 A. M. of May 4th to Cape North (the northern point of Cape Britannia Island). From this camp, after a sleep, I sent back two more Eskimos and the twelve poorest dogs, leaving Henson, one Eskimo, and myself, with three sledges and sixteen dogs, for the permanent advance party.

From Cape North a ribbon of young ice on the so-called tidal crack, which extends along this coast, gave us a good lift nearly across Nordenskjold Inlet. Then it became unsafe, and we climbed a heavy rubble barrier to the old floe ice inside, which we followed to Cape Benét, and camped. Here we were treated to another snowstorm.

Another strip of young ice gave us a passage nearly across Mascart Inlet, until, under Cape Payer, I found it so broken up that two of the sledges and nearly all of the dogs got into the water before we could escape from it. Then a pocket of snow, thigh and waist deep, over rubble ice under the lee of the Cape stalled us completely. I pitched the tent, fastened the dogs, and we devoted the rest of the day to stamping a road through the snow with our snow shoes. Even then, when we started the next day I was obliged to put two teams to one sledge in order to move it.

Cape Payer was a hard proposition. The first half of the distance round it we were obliged to cut a road, and on the latter half, with twelve dogs and three men to each sledge to push and pull them, snowplow fashion, through the deep snow.

Distant Cape was almost equally inhospitable, and it was only after long and careful reconnoissance that we were able to get our sledges past along the narrow crest of the huge ridge of ice forced up against the rocks. After this we had comparatively fair going, on past Cape Ramsay, Dome Cape, and across Meigs Fjord, as far as Mary Murray Island. Then came some heavy going, and at 11.40 P. M. of May 8th we reached Lockwood's cairn on the north

end of Lockwood Island. From this cairn I took the record and thermometer deposited there by Lockwood eighteen years before. The record was in a perfect state of preservation.

One march from here carried us to Cape Washington. Just at midnight we reached the low point, which is visible from Lockwood Island, and great was my relief to see, on rounding this point, another splendid headland, with two magnificent glaciers debouching near it, rising across an intervening inlet. I knew now that Cape Washington was not the northern point of Greenland, as I had feared. It

LATERAL RIVER, BENEDICT GLACIER.

would have been a great disappointment to me, after coming so far, to find that another's eyes had forestalled mine in looking first upon the coveted northern point.

Nearly all my hours for sleep at this camp were taken up by observations and a round of angles. The ice north from Cape Washington was in a frightful condition—utterly impracticable. Leaving Cape Washington we crossed the mouth of the fjord, packed with blue top floe-bergs, to the western edge of one of the big glaciers, and then over the extremity of the glacier itself, camping near the edge of the second. Here I found myself in the midst of the birth-

place of the "floe-bergs," which could be seen in all the various stages of formation. These "floe-bergs" are merely degraded ice-bergs; that is, bergs of low altitude, detached from the extremity of a glacier, which has for some distance been forcing its way along a comparatively level and shallow sea bottom.

From this camp we crossed the second glacier, then a small fjord, where we killed a polar bear.

It was evident to me now that we were very near the northern extremity of the land; and when we came within view of the next point ahead I felt that my eyes rested at last upon the Arctic Ultima Thule (Cape Morris K. Jesup). The land ahead also impressed me at once as showing the characteristics of a musk-ox country.

This point was reached in the next march, and I stopped to take variation and latitude sights. Here my Eskimo shot a hare, and we saw a wolf track and traces of musk-oxen. A careful reconnoissance of the pack to the northward, with glasses, from an elevation of a few hundred feet, showed the ice to be of a less impracticable character than it was north of Cape Washington. What were evidently water clouds showed very distinctly on the horizon. This water sky had been apparent ever since we left Cape Washington, and at one time assumed such a shape that I was almost deceived into taking it for land. Continued careful observation destroyed the illusion. My observations completed, we started northward over the pack, and camped a few miles from land.

The two following marches were made in a thick fog, through which we groped our way northward, over broken ice and across gigantic, wavelike drifts of hard snow. One more march in clear weather over frightful going—consisting of fragments of old floes; ridges of heavy ice thrown up to heights of twenty-five to fifty feet; crevasses and holes, masked by snow; the whole intersected by narrow leads of open water—brought us at 5 A. M. on the 16th of May to the northern edge of a fragment of an old floe bounded by water. A reconnoissance from the summit of a pinnacle of the floe, some fifty feet high, showed that we were on the edge of the disintegrated pack, with a dense water sky not far distant.

My hours for sleep at this camp were occupied in observations, and making a transit profile of the northern coast from Cape Washington eastward.

The next day I started back for the land, reached it in one long march and camped.

Within a mile of our next camp a herd of fifteen musk-oxen lay

fast asleep; I left them undisturbed. From here on, for three marches, we made great distances over good going, in blinding sunshine, and in the face of a wind from the east which burned our faces like a sirocco.

The first march took us to a magnificent cape (Cape Bridgman), at which the northern face of the land trends away to the southeast. This cape is in the same latitude as Cape Washington. The next two carried us down the east coast to the 83d parallel. In the first of these we crossed the mouth of a large fjord penetrating for a long distance in a southwesterly (true) direction. On the next, in a fleeting glimpse through the fog, I saw a magnificent mountain of peculiar contour, which I recognized as the peak seen by me in 1895, from the summit of the interior ice-cap south of Inde pendence Bay, rising proudly above the land to the north. This mountain was then named by me Mt. Wistar. Finally the density of the fog compelled a halt on the extremity of a low point, composed entirely of fine glacial drift, and which I judged to be a small island in the mouth of a large fjord.

From my camp of the previous night I had observed this island (?) and beyond and over it a massive block of a mountain, forming the opposite cape of a large intervening fjord, and beyond that again another distant cape. Open water was clearly visible a few miles off the coast, while not far out dark water clouds reached away to the southeast.

At this camp I remained two nights and a day, waiting for the fog to lift. Then, as there seemed to be no indication of its doing so, and my provisions were exhausted, I started on my return journey at 3.30 A. M. on the 22d of May, after erecting a cairn, in which I deposited the following record:

COPY OF RECORD IN CAIRN AT CLARENCE WYCKOFF ISLAND.

Arrived here at 10.30 P. M., May 20, from Etah via Fort Conger, and north end of Greenland. Left Etah March 4th. Left Conger April 15th. Arrived north end of Greenland May 13th. Reached point on sea-ice latitude 83 degrees 50′ N., May 16th.

On arrival here had rations for one more march southward. Two days dense fog have held me here. Am now starting back.

With me are my man Mathew Henson; Ahngmalokto, an Eskimo; sixteen dogs and three sledges.

This journey has been made under the auspices of and with funds furnished by the Peary Arctic Club of New York City.

The membership of this Club comprises Morris K. Jesup, Henry W. Cannon, Herbert L. Bridgman, John Flagler, E. C. Benedict, James J. Hill, H. H. Bene-

dict, Fredk. E. Hyde, E. W. Bliss, H. H. Sands, J. M. Constable, C. F. Wyckoff, E. G. Wyckoff, Chas. P. Daly, Henry Parish, A. A. Raven, G. B. Schley, E. B. Thomas, and others.

R. E. PEARY,
Civil Engineer U. S. N.

The fog kept company with us on our return almost continuously until we had passed Lockwood Island, but as we had a trail to follow, did not delay us as much as the several inches of heavy snow that fell in a blizzard, which came from the polar basin, and imprisoned us for two days at Cape Bridgman.

CAPE MORRIS K. JESUP, MOST NORTHERLY KNOWN LAND.

At Cape Morris K. Jesup, the northern extremity, I erected a prominent cairn, in which I deposited the following record:

COPY OF RECORD IN NORTH CAIRN.

May 13, 1900—5 A.M.

Have just reached here from Etah via Ft. Conger. Left Etah March 4th. Left Conger April 15th. Have with me my man Henson, an Eskimo Ahngmalokto, 16 dogs and three sledges; all in fair condition. Proceed to-day due North (true) over sea-ice. Fine weather. I am doing this work under the auspices of and with funds furnished by the Peary Arctic Club of New York City.

The membership of this Club comprises, Morris K. Jesup; Henry W. Cannon; Herbert L. Bridgman; John H. Flagler; E. C. Benedict; Fred'k E. Hyde; E. W.

Bliss; H. H. Sands; J. M. Constable; C. F. Wyckoff; E. G. Wyckoff; Chas. P. Daly; Henry Parish; A. A. Raven; E. B. Thomas and others.

R. E. Peary,
Civil Engineer, U. S. N.

May 17.

Have returned to this point. Reached 83 degrees 50′ N. lat. due north of here. Stopped by extremely rough ice, intersected by water cracks. Water sky to north. Am now going east along the coast. Fine weather.

May 26.

Have again returned to this place. Reached point on East Coast about N. Lat. 83 degrees. Open water all along the coast a few miles off. No land seen to north or east. Last seven days continuous fogs, wind and snow. Is now snowing, with strong westerly wind. Temperature 20° F. Ten musk-oxen killed east of here. Expect start for Conger tomorrow.

At Cape Washington, also, I placed a copy of Lockwood's record, from the cairn at Lockwood Island, with the following indorsement:

This copy of the record left by Lieut. J. B. Lockwood and Sergt. (Now Colonel) D. L. Brainard U. S. A. in the cairn on Lockwood Island southwest of here May 16, 1882, is to-day placed by me in this cairn on the farthest land seen by them, as a tribute to two brave men, one of whom gave his life for his Arctic work.

May 29, 1900.

For a few minutes on one of the marches the fog lifted, giving us a magnificent panorama of the north coast mountains. Very sombre and savage they looked, towering white as marble with the newly fallen snow, under their low, threatening canopy of lead-colored clouds. Two herds of musk-oxen were passed, one of fifteen and one of eighteen, and two or three stragglers. Four of these were shot for dog-food, and the skin of one, killed within less than a mile of the extreme northern point, has been brought back as a trophy for the Club.

Once free of the fog off Mary Murray Island we made rapid progress, reaching Cape North in four marches from Cape Washington. Clear weather showed us the existence of open water a few miles off the shore, extending from Dome Cape to Cape Washington. At Black Cape there was a large open water reaching from the shore northward. Everywhere along this coast I was impressed by the startling evidence of the violence of the blizzard of a few days before. The polar pack had been driven resistlessly in against the iron coast, and at every projecting point had risen to the crest of the ridge of old ice, along the outer edge of the ice-foot, in a terrific cataract of huge blocks. In places these mountains of shat-

tered ice were 100 feet or more in height. The old ice in the bays and fjords had had its outer edge loaded with a great ridge of ice fragments, and was itself cracked and crumpled into huge swells by the resistless pressure. All the young ice which had helped us on our onward passage had been crushed into countless fragments and swallowed up in the general chaos.

Though hampered by fog, the passage from Cape North to Cape Bryant was made in twenty-five and one-half marching hours. At seven A.M. of the 6th of June we camped on the end of the ice-foot, at the eastern end of Black Horn Cliffs. A point a few hundred feet up the bluffs, commanding the region in front of the cliffs, showed it to be filled by small pieces of old ice, held in place against the shore by pressure of the outside pack. It promised at best the heaviest kind of work, with the certainty that it would run abroad at the first release of pressure.

The next day, when about one-third the way across, the ice did begin to open out, and it was only after a rapid and hazardous dash from cake to cake that we reached an old floe, which, after several hours of heavy work, allowed us to climb upon the ice-foot of the western end of the Cliffs.

From here on rapid progress was made again, three more marches taking us to Conger, where we arrived at 1.30 A.M., June 10, though the open water between Repulse Harbor and Cape Brevoort, which had now expanded down Robeson Channel to a point below Cape Sumner, and the rotten ice under Cape Sumner, hampered us seriously. In passing I took copies of the Beaumont English Records from the cairn at Repulse Harbor, and brought them back for the archives of the Club. They form one of the finest chapters of the most splendid courage, fortitude and endurance, under dire stress of circumstances, that is to be found in the history of Arctic explorations.

In this journey I had determined, conclusively, the northern limit of the Greenland Archipelago or land group, and had practically connected the coast southward to Independence Bay, leaving only that comparatively short portion of the periphery of Greenland lying between Independence Bay and Cape Bismarck indeterminate. The non-existence of land, for a very considerable distance to the northward and northeastward, was also settled, with every indication pointing to the belief that the coast along which we travelled formed the shore of an uninterrupted central Polar sea, extending to the Pole, and beyond to the Spitzbergen and Franz Josef Land groups of the opposite hemisphere.

The origin of the floe-bergs and paleocrystic ice was definitely determined. Further than this, the result of the journey was to eliminate this route as a desirable or practicable one by which to reach the Pole. The broken character of the ice, the large amount of open water, and the comparatively rapid motion of the ice, as it swung round the northern coast into the southerly setting East Greenland current, were very unfavorable features.

During my absence some thirty-three musk-oxen and ten seals had been secured in the vicinity of Conger; caches for my return had been established at Thank God Harbor, Cape Lieber, and Lincoln Bay, and sugar, milk and tea had been brought up from the various caches between Conger and Cape Louis Napoleon.

July was passed by a portion of the party in the region from Discovery Harbor westward, *via* Black Rock Vale and Lake Hazen, where some forty musk-oxen were secured.

During August and early September various other hunting trips of shorter duration were made, resulting in the killing of some twenty musk-oxen.

1900–1901.

In the middle of September I started with Henson and four Eskimos to Lake Hazen, to secure musk-oxen for our winter supply, it being evident that my ship would not reach us. Going west as far as the valley of the Very River, by October 4, ninety-two musk-oxen had been killed. Later nine more were secured, making a total of one hundred and one for the autumn hunting.

From the beginning of November to March 6th, the greater portion of the time was passed by my party in igloos built in the vicinity of the game killed in various localities, from Discovery Harbor to Ruggles River.

April 5th I left Conger with Henson, one Eskimo, two sledges and twelve dogs for my northern trip. At the same time the remainder of the party, with two sledges and seven dogs and pups, started south for Capes D'Urville and Sabine, to communicate with or obtain tidings of my ship. On reaching Lincoln Bay it was evident to me that the condition of men and dogs was such as to negative the possibility of reaching the Pole, and I reluctantly turned back.

Arriving at Conger, after an absence of eight days, I found the remainder of my party there. They had returned after an absence of four days, having proceeded one-third of the distance across Lady Franklin Bay. Fortunately, the night before I arrived, one

of the Eskimos secured several musk-oxen above St. Patrick's Bay, which enabled me to feed my dogs before starting south, which I did with the entire party on April 17.

April 30, at Hayes Point, I met the party from the *Windward* attempting to reach Conger, and received my mail, learning that the *Windward* was at Payer Harbor with Mrs. Peary and our little girl on board. After a rest at the D'Urville box-house, I went on to the *Windward*, arriving May 6th.

After a few days' rest the work of establishing new caches along the coast northward, towards Conger, was commenced and continued until the middle of June. Then the preparing of Payer Harbor for winter quarters was carried on till July 3d, when the *Windward* broke out of the ice and steamed over to the Greenland side. July was devoted to killing walrus, and 128 were secured and transported to Payer Harbor.

August 4th, the *Erik*, sent up by the Club, in command of Secretary H. L. Bridgman, to communicate with me, arrived at Etah. The usual tour of visits to the Eskimo settlements was then made, and both ships pressed into the work of hunting walrus, until August 24th, when the *Windward* proceeded southward, and the *Erik* steamed away to land me and my party and the catch of walrus at Payer Harbor.

A large quantity of heavy ice blocking the way to Payer Harbor, I requested Secretary Bridgman to land me and my party and walrus meat, in a small bight, some twelve or fifteen miles south of Cape Sabine, from whence I could proceed to Payer Harbor in my boats or sledges when opportunity offered. This was done, and on the 29th of August the *Erik* steamed away.

1901–1902.

On the 16th of Sept. I succeeded in reaching Payer Harbor, crossing Ross Bay, partly by sledge and partly by boat, and going overland across Bedford Pim Island.

Soon after this my Eskimos began to sicken, and by November 19th six of them were dead. During this time I personally sledged much of the material from Erik Harbor to headquarters, and Henson went to the head of Buchanan Bay with some of the Eskimos, and secured ten musk-oxen.

The winter passed quietly and comfortably. Two more musk-oxen were secured in Buchanan Bay, and six deer at Etah.

January 2nd, work was begun in earnest on preparations for the spring campaign, which opened on the 11th of February. On this

day I sent off six sledges, with light loads, to select a road across the mouth of Buchanan Bay, and build an igloo abreast of Cape Albert. On the 12th I sent two of my best hunters on a flying reconnoissance and bear hunt, in the direction of Cape Louis Napoleon.

On the 13th eight sledges went out, taking dog food nearly to Cape D'Urville. On the 16th my two scouts returned with a favorable report, and on the 18th ten sledges went out loaded with dog-food to be taken to Cape Louis Napoleon. This party returned on the 22nd. On the evening of the 28th everything was in readiness for Henson to start the next day, it being my intention to send him on ahead with three picked men and light loads to pioneer the way to Conger; I to follow a few days later with the main party. A northerly gale delayed his departure until the morning of March 3rd, when he got away with six sledges and some fifty dogs. Two of these sledges were to act as a supporting party as far as Cape Lawrence. At nine A.M. of March 6th fourteen sledges trailed out of Payer Harbor and rounded Cape Sabine for the northern journey, and at noon I followed them, with my big sledge, the "Long Serpent," drawn by ten fine grays. Two more sledges accompanied me. The temperature at the time was $-20°$ F. The minimum of the previous night had been $-38°$ F. We joined the others at the igloos abreast of Cape Albert and camped there for the night. Temperature $-43°$ F. The next day we made Cape D'Urville in temperature from $-45°$ to $-49°$ F.

Here I stopped a day to dry our foot gear thoroughly, and left on the morning of the 9th with some supplies from the box house. Two sledges returned from here. Camped about five miles from Cape Louis Napoleon. The next march carried me to Cape Fraser, and the next to Cape Collinson. During this march, for the first time in the four seasons that I have been over this route, I was able to take a nearly direct course across the mouth of Scoresby Bay, instead of making a long detour into it.

One march from Cape Collinson carried me to Cape Lawrence, on the north side of Rawlings Bay. The crossing of this bay, though more direct than usual, was over extremely rough ice. Learning from Henson's letter at Cape Lawrence, that I had gained a day on him, and not wanting to overtake him before reaching Conger, I remained here a day, repairing several sledges which had been damaged in the last march. Five men with the worst sledges and poorest dogs returned from here. Three more marches took us to Cape L. von Buch on the north side of Carl

Ritter Bay, temperature ranging from -35° to -45° F. Heavy going in many places.

Two more marches carried us to the first coast valley north of Cape Defosse. I had now gained two days on the advance party. The character of the channel ice being such that we were able to avoid the terrible ice-foot, which extends from here to Cape Lieber, and my dogs being still in good condition, I made a spurt from here and covered the distance to Conger in one march, arriving about an hour and a half after Henson and his party.

I had covered the distance from Payer Harbor to Conger, some 300 miles, in twelve marches.

Four days were spent at Conger overhauling sledges and harness, drying and repairing clothing, and scouting the country, as far as The Bellows, in search of musk-oxen. None were seen, but about 100 hare were secured in the four days. Temperature during this time from -40° to -57° F. Seven Eskimos returned from here, taking with them the instruments of the Lady Franklin Bay Expedition, and other items of Government property abandoned here in 1883.

On the morning of the 24th I started north with nine sledges. We camped the first night at "Depot B." The next march I had counted on making Lincoln Bay, but just before reaching Wrangel Bay a sudden furious gale with blinding drift drove us into camp at the south point of the bay. Here we were storm-bound during the 26th, but got away on the morning of the 27th and pushed on to Cape Union, encountering along this portion of the coast the steep side slopes of hard snow, which are so trying to men and sledges and dogs.

Open water, the clouds over which we saw from Wrangel Bay Camp, was about 100 yards beyond our igloo, and extended from there, as I judged, northward beyond Cape Rawson, and reached entirely across the channel to the Greenland coast at Cape Brevoort, as in 1900.

Fortunately, with the exercise of utmost care, and at the expense of a few narrow escapes, and incessant hard work, we were able to work our sledges along the narrow and dangerous ice-foot to and around Black Cape.

The ice-foot along this section of the coast was the same as was found here by Egerton and Rawson in 1876, and Pavy in 1882, necessitating the hewing of an almost continuous road; but a party of willing, light-hearted Eskimos makes comparatively easy work of what would be a slow and heartbreaking job for two or three

white men. Beyond Black Cape the ice-foot improved in character, and I pushed along to camp at the *Alert's* winter quarters. Simultaneously with seeing the *Alert's* cairn three musk-oxen were seen a short distance inland, and secured. The animals were very thin and furnished but a scant meal for my dogs.

One march from here carried us to Cape Richardson, and the next under the lee of View Point, where we were stopped and

HEWING A WAY.

driven to build our igloo with all possible speed by one of the common Arçtic gales. There were young ice, pools of water, and a nearly continuous water sky all along the shore.

As the last march had been through deep snow, I did not dare to attempt the English short cut across Feilden Peninsula behind Cape Joseph Henry, preferring to take the ice-foot route round it.

For a short distance this was the worst bit of ice-foot I have ever encountered. By the slipping of my sledge two men nearly

lost their lives, saving themselves by the merest chance, with their feet already dangling over the crest of a vertical face of ice some fifty feet in height. At the very extremity of the cape we were forced to pass our sledges along a shelf of ice less than three feet in width, glued against the face of the cliff at an elevation which I estimated at the time as seventy-five feet above the ragged surface of the floe beneath. On the western side of the cape the ice-foot broadened and became nearly level, but was smothered in such a depth of light snow that it stalled us and we went into camp. The next day we made Crozier Island.

During April 2d and 3d we were held here by a westerly storm, and the 4th and 5th were devoted to hunting musk-oxen, of which three were secured, two of them being very small. From here I sent back three Eskimos, keeping Henson and four Eskimos with me.

Reconnoissances of the polar pack northward were made with the glasses from the summit of the island and from Cape Hecla.

The pack was very rough, but apparently not as bad as that which I saw north of Cape Washington two years before. Though unquestionably difficult, it yet looked as though we might make some progress through it unless the snow was too deep and soft. This was a detail which the glasses could not determine.

On the morning of April 6th I left Crozier Island, and a few hours later, at the point of Cape Hecla, we swung our sledges sharply to the right and climbed over and down the parapet of the ice-foot onto the polar pack. As the sledges plunged down from the ice-foot their noses were buried out of sight, the dogs wallowed belly deep in the snow, and we began our struggle due northward.

We had been in the field now just a month. We had covered not less than 400 miles of the most arduous travelling in temperatures of from 35° to 57° F., and we were just beginning our work, *i. e.*, the conquest of the polar pack, the toughest undertaking in the whole expanse of the Arctic region.

Some two miles from the cape was a belt of very recent young ice, running parallel with the general trend of the coast. Areas of rough ice caught in this compelled us to exaggerated zigzags, and doubling on our track. It was easier to go a mile round, on the young ice, than to force the sledge across one of these islands.

The northern edge of the new ice was a high wall of heavily-rubbled old ice, through which, after some reconnoissance, we found a passage to an old floe, where I gave the order to build an igloo. We were now about five miles from the land.

The morning of the 7th brought us fine weather. Crossing the old floe we came upon a zone of old floe fragments deeply blanketed with snow. Through the irregularities of this we struggled; the dogs floundering, almost useless, occasionally one disappearing for a moment; now treading down the snow round a sledge to dig it out of a hole into which it had sunk, now lifting the sledges bodily over a barrier of blocks; veering right and left; doubling in our track; road-making with snow-shoe and pickaxe.

Late in the day a narrow ditch gave us a lift for a short distance, then one or two little patches of level going, then two or three small old floes which, though deep with snow, seemed like a Godsend compared with the wrenching earlier work. We camped in the lee of a large hummock on the northern edge of a small but very heavy old floe, every one thoroughly tired, and the dogs dropping motionless in the snow as soon as the whip stopped.

We were now due north of Hecla, and I estimated we had made some six miles, perhaps seven, perhaps only five. A day of work like this makes it difficult to estimate distances. This is a fair sample of our day's work.

On the 12th we were storm-bound by a gale from the west, which hid even those dogs fastened nearest to the igloo. During our stay here the old floe on which we were camped split in two with a loud report, and the ice cracked and rumbled and roared at frequent intervals.

In the first march beyond this igloo we were deflected westward by a lead of practically open water, the thin film of young ice covering it being unsafe even for a dog. A little further on a wide canal of open water deflected us constantly to the northwest and then west until an area of extremely rough ice prevented us from following it farther. Viewed from the top of a high pinnacle this area extended west and northwest on both sides of the canal, as far as could be seen. I could only camp and wait for this canal, which evidently had been widened (though not newly formed) by the storm of the day before, to close up or freeze over. During our first sleep at this camp there was a slight motion of the lead, but not enough to make it practicable. From here I sent back two more Eskimos.

Late in the afternoon of the 14th the lead began to close, and hastily packing the sledges we hurried them across over moving fragments of ice. We now found ourselves in a zone of high parallel ridges of rubble ice covered with deep snow. These ridges were caused by successive opening and closing of the lead. When,

after some time, we found a practicable pass through this barrier, we emerged upon a series of very small but extremely heavy and rugged old floes; the snow on them still deeper and softer than on the southern side of the lead. At the end of a sixteen-hour day I called a halt, though we were only two or three miles north of the big lead.

During the first portion of the next march we passed over fragments of very heavy old floes slowly moving eastward. Frequently we were obliged to wait for the pieces to crush close enough together to let us pass from one to the other. Farther on I was compelled to bear away due east by an impracticable area extending west, northwest, north and northeast as far as could be seen, and just as we had rounded this and were bearing away to the north again, we were brought up by a lead some fifty feet wide. From this on, one day was much like another, sometimes doing a little better, sometimes a little worse, but the daily advance, in spite of our best efforts, steadily decreasing. Fog and stormy weather also helped to delay us.

I quote from my journal for April 21st:

> The game is off. My dream of sixteen years is ended. It cleared during the night and we got under way this morning. Deep snow. Two small old floes. Then came another region of old rubble and deep snow. A survey from the top of a pinnacle showed this extending north, east and west, as far as could be seen. The two old floes, over which we had just come, are the only ones in sight. It is impracticable and I gave the order to camp. I have made the best fight I knew. I believe it has been a good one. But I cannot accomplish the impossible.

A few hours after we halted there came from the ice to the north a sound like that made by a heavy surf, and it continued during our stay at this camp. Evidently the floes in that direction were crushing together under the influence of the wind, or what was, perhaps, more probable, from the long continuation of the noise, the entire pack was in slow motion to the east. A clear day enabled me to get observations which showed my latitude to be 84 degrees 17′ 27″ N., magnetic variation 99° west. I took some photographs of the camp, climbed and floundered through the broken fragments and waist-deep snow for a few hundred yards north of the camp, gave the dogs a double ration, then turned in to sleep, if possible, for a few hours preparatory to returning.

We started on our return soon after midnight of the 21st. It was very thick, with wind from the west and snowing heavily. I hurried our departure in order to utilize as much of our tracks as possible before they were obliterated. It was very difficult to keep the trail in the uncertain light and driving snow. We lost it re-

peatedly, when we would be obliged to quarter the surface like bird dogs. On reaching the last lead of the upward march, instead of the open water which had interrupted our progress then, our tracks now disappeared under a huge pressure ridge, which I estimated to be from seventy-five to one hundred feet high. Our trail was faulted here by the movement of the floes, and we lost time in picking it up on the other side. This was to me a trying march. I had had no sleep the night before, and to the physical strain of handling my sledge was added the mental tax of trying to keep the trail. When we finally camped, it was only for a few

CAMP AT 84° 17′ N. LAT., APRIL 21, 1902.

hours, for I recognized that the entire pack was moving slowly, and that our trail was everywhere being faulted and interrupted by new pressure ridges and leads, in a way to make our return march nearly, if not quite, as slow and laborious as the outward one. The following marches were much the same. In crossing one lead I narrowly escaped losing two sledges and the dogs attached to them. Arrived at the "Grand Canal," as I called the big lead at which I had sent two Eskimos back, the changes had been such as to make the place almost unrecognizable.

Two marches south of the Grand Canal the changes in the ice

had been such, between the time of our upward trip and the return of my two men from the canal, that they, experienced as they were in all that pertains to ice-craft, had been hopelessly bewildered and wandered apparently, for at least a day, without finding the trail. After their passage other changes had taken place, and, as a result, I set a compass course for the land, and began making a new road. In the next march we picked up our old trail again.

Early in the morning of the 22d, we reached the second igloo out from Cape Hecla, and camped in a driving snowstorm. At this igloo we were storm-bound during the 27th and 28th, getting away on the 29th in the densest fog, and bent on butting our way in a "bee" line compass course, for the land. Floundering through the deep snow and ice, saved from unpleasant falls only by the forewarning of the dogs, we reached Crozier Island after a long and weary march. The band of young ice along the shore had disappeared, crushed up into confused ridges and mounds of irregular blocks.

The floe at the island camp had split in two, the crack passing through our igloo, the halves of which stared at each other across the chasm. This march finished two of my dogs, and three or four more were apparently on their last legs. We did not know how tired we were until we reached the island. The warm foggy weather and the last march together dropped our physical barometer several degrees.

As we now had light sledges, I risked the short cut across the base of Feilden Peninsula and camped that night under the lee of View Point. Four more marches carried us to Conger, where we remained three days, drying clothing and repairing sledges, and giving the dogs a much-needed rest. Leaving Conger on the 6th of May, eleven marches brought us back to Payer Harbor on the 17th of May. A few days after this I went north to complete the survey of the inner portions of Dobbin Bay, being absent from headquarters some ten days. Open water vetoing a trip which I had planned for June up Buchanan Bay and across to the west coast of Ellesmere Land, the remainder of the time was devoted to assiduous hunting, in order to secure a supply of meat for the winter, in the contingency of no ship arriving.

On the 5th of August the new *Windward*, sent north by the Club, and bringing to me Mrs. Peary and my little girl, steamed into the harbor. As soon as people and supplies could be hurried aboard her, she steamed across the Sound to the Greenland side. Here my faithful Eskimos were landed, and, after devoting a week

or so to the work of securing sufficient walrus to carry them in comfort through the winter, the *Windward* steamed southward, and, after an uneventful voyage, arrived at Sydney, C. B., on the 17th of September, where I had the pleasure of meeting Secretary Bridgman, of the Club, and forwarding through him a brief report of my movements during the past year.

R. E. PEARY, C.E., U.S.N.

MEMORANDUM.—The Peary Arctic Club, an unincorporated association of contributors to the expedition of 1898–1902, met for the first time at 44 Pine street, New York, January 29, 1899, and having before it Commander Peary's letters and reports from Etah, North Greenland, August 12, 1898, the date of the separation of its steamers Hope and Windward, elected the following officers: President, Morris K. Jesup; Vice-President, Frederick E. Hyde; Treasurer, Henry W. Cannon; Secretary, Herbert L. Bridgman. The constitution, the first three sections of which are as follows, the others being merely of routine common to all similar bodies, was adopted:

I.—The name of the association shall be "The Peary Arctic Club."

II.—The objects of the club are to promote and encourage explorations of the Polar regions, as set forth in Lieutenant R. E. Peary's letter to the American Geographical Society, dated January 14, 1897, and to assist him in the geography of the same; to receive and collect such objects of scientific interest, or otherwise, as may be obtainable through Lieutenant Peary's present expedition, or other expeditions of like nature; to receive, collect and keep on file narratives and manuscripts relative to Arctic explorations; to preserve such records and keep such accounts as may be necessary for the purposes of the association; and further, to command in its work the resources of mutual acquaintance and social intercourse.

III.—Contributors to the Peary expedition of 1898 are founders of this association.

Alfred C. Harmsworth, of the London Daily Mail, was elected honorary member, in recognition of his service to the expedition.

The club chartered the steamer Diana, Captain Samuel W. Bartlett, of St. Johns, Newfoundland, and dispatched her on July 22, 1899, from Sydney, C. B., laden with ample stores and equipment. Junction with Commander Peary and the Windward, which had wintered in Allman Bay, on the western side of Smith Sound, was effected at Etah, August 12; the Windward took her departure for the South, August 22, arriving at Brigus, N. F., September 13; the Diana, having discharged her cargo at Etah, Peary's headquarters, 1899–1900, following one week later and arriving at Sydney, C. B., September 15. The Windward brought the original scientific records and the personal effects of each officer and man of the Lady Franklin Bay Expedition; the sextant abandoned in 1876 by Lieutenant, now Rear-Admiral, Albert Beaumont, R. N., at Cape Britannia, Greenland, and copies of the Nares–Markham records from the Norman Lockyer and Washington Irving Island cairns, all recovered by Commander Peary in 1898 and 1899. The personal effects were subsequently distributed by the club to the survivors and the next of kin of the deceased, and the

relics of the Royal Navy deposited through the Lords of the Admiralty in the Royal Naval Museum at Greenwich.

The Windward, having been repaired and improved, sailed from Sydney, C.B., July 21, 1900, under Captain Samuel W. Bartlett, with Mrs. Peary and Ahnighito Peary on board, with instructions to proceed to Etah, and failing to find there Commander Peary, to cross Smith Sound to Cape Sabine, and push northward as far as might be necessary to open communication with him. The club chartered in 1901 the steamer Erik, Captain John W. Blakeney, and dispatched her from Sydney, C. B., on July 18, with instructions to proceed to Etah, where, on August 5, junction was effected with Commander Peary and the Windward, which had been ice-bound in Payer Harbor during the entire winter. The Erik and Windward spent August in the north waters, the former arriving at Sydney September 15, and the latter at Brigus, N. F., September 24. The Erik brought Commander Peary's report of his delineation of the northern end of Greenland in 1900, and Lockwood's original record from his cairn of 1882, at his farthest.

The club installed new boilers and engines in the Windward at Newburgh, N.Y., in 1902, and on July 20 of that year she sailed a third time for the North, effecting junction with Commander Peary August 5 at Cape Sabine, and returning with him to Sydney, C. B., September 15. He brought also from Fort Conger the library, instruments, and all the remaining equipment of the Lady Franklin Bay Expedition.

The founders of the club were: Morris K. Jesup, Henry W. Cannon, James J. Hill, John M. Flagler, Frederick E. Hyde, E. C. Benedict, H. Hayden Sands, A. A. Raven, Henry Parish, Eben B. Thomas, James M. Constable, Herbert L. Bridgman, Henry H. Benedict and Eliphalet W. Bliss.

Full contributing members, Edward G. Wyckoff and Clarence W. Wyckoff, of Ithaca, N. Y., and Grant B. Schley, of New York, were in 1898 elected to membership in the club, and President Charles P. Daly, of the American Geographical Society, to its executive committee, in recognition of the contribution by the Society.

GEOGRAPHICAL RECORD.

AMERICA.

CHANNELS FORMED ALONG ICE MARGIN IN CENTRAL NEW YORK.—In the 20th Annual Report of the New York State Geologist, Fairchild described some channels which he attributed to the work of streams flowing along the margin of the great ice-sheet when it was melting away from the northern central part of New York. By later work he has gathered facts leading him to the conclusion that there are other and lower channels farther north, between Syracuse and Rome. His results are presented in a brief article (21st Report N. Y. State Geologist, 1901, pp. 233–247), illustrated by four maps and 21 full-page half tones. These channel-ways, in some of which only one bank is preserved (the other having been

ice), while in others there are two banks, extend from Syracuse to Rome approximately along the line of the New York Central Railway and Erie Canal, both of which, in fact, sometimes follow the grade of the old glacial stream beds.

One of these marginal rivers is believed to have formed the valley which enters the City of Syracuse from the west, past Burnet Park, and leaves the city on the east along the line followed by the canal and the railways, being traceable as far as East Syracuse. "The business section of Syracuse and all the south part of the city occupy the detrital plain or delta which accumulated in the Onondaga embayment by the great river which cut the Burnet Park channel, and partly through more recent work of the Onondaga Creek."

These preliminary notes are of distinct interest, but glacial geologists await with especial interest the publication of the final paper, with full discussion of the phenomena, which Fairchild promises. R. S. T.

Detailed Pleistocene Mapping in New England.—In mapping the Pleistocene geology of the Housatonic Folio in western Massachusetts, Mr. F. B. Taylor has experienced no little difficulty in accounting for the phenomena which he has met in the field. His paper on The Correlation and Reconstruction of Recessional Ice Borders in Berkshire County, Massachusetts (Journal of Geology, Vol. XI, No. 4, 1903, pp. 323–364), published in advance of the appearance of the folio, is his forewarning of the introduction into Pleistocene work of an element hitherto unused—interpolation.

The region comprises the southern two-thirds of Berkshire County and includes portions of Connecticut and New York. The rocks are crystalline, there has been little glacial erosion, and an exceedingly rugged topography has greatly complicated ice movement. A main north-south valley with a north-flowing and a south-flowing stream, a broad lateral valley at right angles to it, two main mountain masses, rising well above 2,000 feet, and deep valleys trenching the main plateau characterize the region.

Taylor finds that the eastern limb of the Hudson valley lobe of the continental glacier covered this region with thick ice, which retreated across it from southeast to northwest, building recessional moraines, fifteen in number, about every 3½ miles. The valleys contain the best moraines, in the form of terminal deposits; but he also finds lateral moraines, stoss moraines, marginal drainage

channels, kames, eskers, moraine-headed gravel trains, and deltas associated with marginal lakes. Between these deposits there are, however, extensive areas of hillside and hilltop on which no evidence of terminal deposits was found. The purpose of his paper is to state his method of restoring the position of the ice margin in these intervals.

That interpolation will be necessary in detailed Pleistocene mapping is certain, and to Taylor belongs the credit of making the first attempt. The value of one's results in this direction will, of course, depend upon the correctness of the principles upon which the interpolation is based. Among the important basal principles which Taylor proposes for this region are the following: The main ice retreat was from southeast to northwest; the ice tongues of the various valleys moved synchronously, therefore admitting of no overlapping of morainic deposits; the slope along the margin of the ice tongues was uniformly about 100 feet per mile.

From merely reading the summary statements of the paper the reviewer is not fully convinced of the unquestionableness of some of these premises, on which the proposed reconstruction stands or falls; for instance, the matter of contemporaneous movements for all valley tongues and its vitally important elimination of possible overlappings. The question arises also as to whether there was such a uniform rate of slope as is assumed; whether, for example, full allowance is made for the effect of difference in width of valley, slope of valley floor, direction of the valley relatively to the main ice movement, and nearness to actively-moving ice. That there was not local glaciation of the Greylock mass—rising 3,500 feet—and of Mt. Everett, which is 2,600 feet in elevation, influencing ice-tongue movement, is a point that Mr. Taylor may have determined, but which, if not eliminated, must surely be considered. These questions are raised in no spirit of captious criticism, but with full recognition of the difficulties which confronted the author and sympathy with his efforts to establish a working basis for successful interpolation.

Interpolation will be used only as a last resort, and doubtless Taylor has exhausted all the possibilities of actually tracing ice-front deposits from valley to valley, and has thus been forced to attempt a reconstruction from fragmentary data. That there should not be ice-front deposits on some of the hills seems remarkable. In the hilly, dissected plateau of southern central New York, ice-margin deposits are traceable over hills 1,800 feet high, though sometimes with great difficulty. The more rugged topo-

graphy and harder rock of the Berkshires may account for the absence of similar records of ice-fronts there.

R. S. T.

Glacial Geology in the United States Geological Survey Geologic Folios.—The earlier folios of the Geological Survey dealt largely with areas presenting economic problems; now the work is being extended to other regions, and ultimately the entire country will be covered. About 100 folios have so far appeared.

In some of the more recent folios the study of the glacial deposits is being made one of the special features, and maps are prepared to show their nature and distribution. Several folios that have already appeared contain such maps, and others are being prepared. Among those so far published are the Holyoke, Mass.; Danville, Ill.; Ditney, Ind.; Elkland, Tioga, Pa.; Gaines, Pa.-N.Y., New York City, and Chicago folios.

The undertaking of this work marks an important event in American glacial geology, for it inaugurates new methods in the study of the glacial deposits. While some of the main facts of glacial geology have been discovered, and many working hypotheses proposed, the time has come when, in order to make much further progress, work of intimate detail must needs be done in many areas. The preparation of these folios will provide the opportunity for such study; and with the facts thus gathered rival hypotheses may be tested and unexplained phenomena accounted for. The present condition of glacial geology indicates that this gathering of facts is now its greatest need.

R. S. T.

Yosemite Valley.—Although many have studied the Yosemite region, there is still a difference of opinion concerning the cause of the remarkable valley and the falls. One hypothesis is that the deep main valley was cut out by stream erosion before the glacial period; another that it is due to ice erosion; a third that there has been a downfaulting of the valley bottom. By either explanation the tributary valleys from which the waterfalls are supplied are supposed to have been left hanging above the bottom of the main, over-deepened valley.

Prof. Branner (Journ. Geol. XI, 1903, p. 547) accepts the river erosion theory of Turner, according to which the influence of rock and joint planes has had much to do in determining the peculiar topography of the valley. He also draws attention to an interesting phenomenon—namely, the presence of a gorge at one side of the

hanging tributary valleys and deeper than the gorge through which the waters now pass. This is true not only in the Yosemite Fall but also in the Illilouette and Nevada Falls. Branner accounts for this by the erosive action of a glacial stream flowing along the ice margin when the side valleys were filled with valley glaciers. When the ice tongues disappeared these short gorges were abandoned because, although they formed notches in the valley edge, they did not lead back to the axes of the side valleys. Seen from below one wonders why the water of the falls does not emerge from these lower notches; but from above it is seen that there is no connection between the notches and the valley axes.

R. S. T.

Expedition to the Bahama Islands.—The Geographical Society of Baltimore, which was organized in October, 1902, fitted out a two-masted sailing vessel last spring for scientific work in the region of the Bahama Islands. The expedition, which was directed by Dr. George B. Shattuck of Johns Hopkins University, left Baltimore on June 1, 1903. The scientific staff numbered 22, the chiefs being Dr. Shattuck of the geological staff; Dr. W. C. Coker of the University of North Carolina, botany; Mr. Barton A. Bean, curator of fishes in the United States National Museum, marine zoology; Mr. J. H. Riley, curator in the National Museum, land zoology; Dr. Oliver L. Fassig, United States Weather Bureau, climatology and physics; and Mr. C. N. Mooney, Department of Agriculture, soil survey.

A report of the work of the expedition, written by Dr. Shattuck, appeared in *Science* (No. 457, pp. 427–32). The survey ascertained that the matter composing the Bahama Islands is not entirely made up of wind-blown coral and lime sand, but that the lower part of many islands, extending from 10 to 25 feet above the present mean tide, was deposited by the ocean, and contains marine organisms in large numbers. On this lies the deposit of wind-blown material. Both elevations and depressions have occurred; a beach mark and tide gauge were set up at Nassau to settle the question whether either process is now going on.

In the botanical department about 500 plants were collected for future study, including the lower forms of plant life, such as seaweed, fresh and salt water algæ, fungi, and lichens. The principal work was the study of plants in relation to environment.

About 1,000 specimens of marine life, 260 skins of representative birds, 100 of reptiles, and 300 of mammals were collected for

the National Museum, and interesting results were accomplished in other departments. The medical survey showed the prevalence of leprosy, the better physical types presented by the pure blacks or whites in contrast with those of mixed blood, and the better health in islands depending for food chiefly upon farm products, as compared with those in which marine food is the chief reliance.

HOVEY ON WEST INDIAN VOLCANOES.—The dramatic events associated with the eruption of Mont Pelé and La Soufrière, a year and a half ago, together with the accessibilty of the region, have led to such a thorough study of the eruptions and their effects that these volcanoes promise to serve as standard examples of volcanic eruptions, possibly replacing in part the time-honoured Vesuvius. One of the most active workers in this field has been Dr. E. O. Hovey, who has given to us not only many new facts of his own observation but summaries of the results obtained by other workers.

Just when the interest of people was beginning to flag, because of the over-supply of articles on these volcanoes, Pelé caused a revival of interest by the development of a new feature in the form of a spine or tooth which at one time reached a height of more than 1,000 feet. This spine, which rose from one side of the crater, has suffered many changes since it first appeared, and in a recent article (Amer. Journ. Sci., XVI, Oct., 1903, pp. 269–281) Hovey describes these changes, also presenting a number of excellent illustrations. He explains the phenomenon as follows:

> The spine or tooth consists of solid rock, which seems to have been pushed up bodily into its present position, and to be maintained there, somewhat like the stopper in a bottle, by friction against the sides of the neck and by the expansive forces underneath. The shape of the spine, with its sides forming angles of 75°, 87°, and even 90° with the horizontal, is a strong argument against the theory that it has been formed by ejected blocks or bombs which were sufficiently pasty to stick together on falling, and in favour of the "stopper theory." Furthermore, the northeast side of the spine presents a fairly smooth, vertically-grooved surface, as if it had been slicken-sided by friction against the side of the conduit during its ascent (see figs. 5, 6, and 7, Pl. XII, XIII). The great and sudden changes in the altitude of the spine with reference to the rest of the cone point in the same direction.

In a short article in *Science* (Vol. XVIII, Nov. 13, 1903, pp. 633–634) Hovey extends the history of the spine from May to October. In this, after describing numerous variations in the spine, he states that this phenomenon, which "was such a wonderful part of the mountain from November, 1902, to June, 1903, had practically disappeared early in August," 1903.

The same author has published in the American Museum Journal (Vol. III, 1903, pp. 41–54) a preliminary note on his observations during a recent visit to the volcanic islands of the Antillian chain. In this he briefly describes the condition of the volcanoes and presents some interesting photographs. The cone of Pelé has increased in height from 4,428 to 5,150 feet, and the valley of the Rivière Blanche has been decidedly filled with ash. Denudation has also been vigorously at work on the loose ash both in Martinique and St. Vincent. Hovey states, for example, that in a few months not less than 150,000,000 cubic feet of material have been removed from the gorge of the Wallibou in St. Vincent. The publication of his final report will be awaited with interest.

R. S. T.

Secondary Phenomena of the West Indian Volcanic Eruptions in 1902.—Mr. George C. Curtis describes (Journal of Geology, Vol. XI, 1903) some interesting phenomena connected with the eruptions in Martinique and St. Vincent. The mud-flows, which are an important phenomenon in connection with these eruptions, he believes to have been caused by the discharge of the waters of crater lakes over the mountain sides. The hot volcanic ash in the stream beds gave rise to phenomena of secondary eruptions, which he calls geyser-like eruptions, in which steam rose in some cases to a height of over 3,000 feet. It was such eruptions that gave rise to the early theory that St. Pierre was destroyed from a secondary crater in the valley on the mountain side. These secondary eruptions are due to the influx of water to the hot ash beds, which transformed it to steam, causing explosions; and Curtis suggests several reasons why there may be sufficient concentration of steam to cause such explosions. The geyser-like eruptions formed ash cones with craters closely resembling those of volcanoes, and the material of which they are made is in some cases fragments, the size of a man's head. In valleys down which the mud-flows passed, the surface often has a hummocky topography, resembling in form that of sand dunes, to which Curtis gives the name ash cone topography. This he believes to have been caused by numerous explosions, varying in violence, and more or less modified by shifting of vents, migration of stream channels, and other causes.

R. S. T.

Harbour Works at Rio de Janeiro.—The Brazilian Government has signed a contract with a British firm to make improvements in the harbour of Rio to be completed in 1910. Though

the bay is 68 square miles larger than the lower and upper bays of New York together, the water near the shores is shallow, the bottom is silting up, and no large vessels are able to tie up along shore. A sea wall or quay, two miles in length, is to be built along the entire northern front of the city. The quay will be wide enough for railroad trains and wagons to move along it. Outside of the quay a channel will be dredged to a width of 820 feet and a depth of from 26 to 33 feet, so that the largest shipping can be accommodated. Vessels will tie up along the front of the sea wall and cars and wagons will carry freight to or from them.

CLIMATE OF THE ARGENTINE REPUBLIC, Compiled from Observations made to the End of the Year 1900. By Walter G. Davis, Director of the Argentine Meteorological Office. Fol. Buenos Aires, 1902, pp. 154. Pls. XXVI. Text in Spanish and English.

In the Second Census of the Argentine Republic (May 10, 1895), published in 1898, there was a chapter on Climate, written by Mr. Walter G. Davis, Director of the Argentine Meteorological Office. This chapter was in Spanish. It has now been reprinted, in Spanish and English, with the addition of newer data to the end of 1900, and of a larger number of stations. Altogether, the volume is one of the best publications on the climate of one country which we have seen, and bears witness to the excellent work which Mr. Davis is doing in his adopted land. The Argentine Meteorological Service now stands with most of the services of the North Temperate Zone, and is a splendid monument to the skill, the energy, and the scientific ability of its directors.

The treatment of all the climatic elements is thoroughly scientific and complete. In fact, the volume might well serve as a model for future investigations of this sort. The Republic may be divided into three general climatic provinces, on the basis of the temperature and rainfall, the Littoral, the Mediterranean and the Andine, the axes of greatest elongation being north and south, and each of these three main divisions being subdivisible into northern, central, and southern sections, whose differences depend chiefly on latitude and altitude. With the great extent of the Argentine, embracing as it does 33° of latitude, the differences between north and south are necessarily very great; but there are also extraordinary changes in temperature and rainfall in going from east to west across country, narrow as it is. Thus, taking the zone of a degree and a half of latitude which lies north of the Tropic of Capricorn,

we find, on the eastern frontier, a mean annual temperature of 73.4°. Crossing the isotherms at right angles, a temperature of less than 57.2° is found at the western limits. As to rainfall, in this same distance of about 500 miles "the aspect of the country changes from the lowlands of the Chaco, covered with a tropical vegetation, to the arid table-lands of Salta and Jujuy, which in turn merge into the Cordilleras, with their highest peaks under the mantle of perpetual snow."

The famous Argentine "zonda" is described as being so dry that people sprinkle their floors and walls to cool the air while it blows. A section is devoted to the temperature of evaporation, which has been called "sensible temperature," and we have never seen a publication which contained tables and charts of sensible temperatures, by months, for a number of stations. Perhaps the most striking feature on any of the charts in the volume is the rapid decrease of pressure south of the 45th parallel, shown on the isobaric maps, the successive isobars running across the country, almost due east and west, close together. This is the natural consequence of the southward extension of South America into the region of permanent low pressure in the Antarctic. The highest relative humidity is found in the north and in the extreme south. In the Andine provinces it frequently happens that the relative humidity does not exceed 2 or 3%. In fact, according to the ordinary psychrometer tables, some observations in this district give a relative humidity of 0%. As this is impossible, it is clear that the reduction formulæ are not applicable to such cases of extreme dryness.

In places near the foothills and eastern slopes in the Andine region rain is almost unknown, while in the extreme northeast the isohyetal line indicates a rainfall of over 80 inches.

Nothing but praise can be given to this admirable volume, which is so complete, so well written, and so abundantly illustrated. Now that attention is being turned more and more to South America, it is well to have such a report at hand for reference. Would that we had something of the sort for the United States!

R. DeC. W.

ASIA.

Philippine Coast Survey.—Mr. George R. Putnam, in charge of the Philippine coast surveys since they were started in January, 1901, informs the *National Geographic Magazine* (Dec., 1903) that during the past year the survey steamer *Pathfinder* has completed

the survey of San Bernardino Strait and Albay Gulf, of San Pedro Bay, and the southern coast of Samar, and has also made a thorough examination of the much-frequented passage southwest of Leyte, where a danger to navigation had been reported. Among the latest harbour surveys are those at Cebu, Ormoc, and Romblon. The small wooden steamer *Research* has made a number of harbour surveys on the west and southeast coasts of Luzon and on Mindanao and Culion Islands, and is now working on the coast of Negros. Chartered launches are also employed in the quieter waters of the deep indentations, and by this means a survey of Lingayen Gulf has recently been completed.

Charts embodying the results of the surveys are prepared in the office at Manila, published by lithography and distributed. Seven pamphlets of sailing directions have been issued, and "Notices to Mariners" are printed from time to time, giving new information of immediate importance, such as dangers discovered, aids to navigation, and changes in the charts.

Many parts of the coasts have as yet been only roughly sketched, while other surveys are controlled by triangulation. There are nearly 1,700 islands in the Philippines that are named, and it is possible to count 3,000 islands and islets on the charts.

MONTHLY NORMALS OF AIR PRESSURE IN INDIA.—Barometric observations in India were originally taken to aid in working out the climatology of that region, and they were not published in the form of daily weather reports. The importance of early information regarding coming weather conditions, and especially regarding rainfall, with the added emphasis which was given to this matter by the occurrence of the Bihar Famine in 1874, the Madras Famine in 1877, and the late and scanty rainfall of the southwest monsoon in 1878, over Northwestern India, led the Government of India to sanction arrangements for the publication of a daily weather report in June, 1878. At first this report included the observations recorded at 10 A. M. at about 100 stations, and a brief summary of the observations, and it was issued without an illustrative chart. The hour of observation was later changed to 8 A. M., the observations being for a time recorded at 8, 10, and 16 hours. The mean monthly pressures for the 10 and 16 hours for the years previous to 1889, and, after that, the mean 8 A. M. monthly pressures, reduced to 32° F. and to constant gravity (Lat. 45°), for all observatories in India which have been in operation at least twenty years, have now been published by Sir John Eliot, Meteorological Reporter to the

Government of India (Vol. XIV, Part II, Indian Meteorological Memoirs), the volume furnishing the most complete information in regard to the pressure conditions of India. It is a noteworthy fact that there are some persistent disagreements between the pressures at some of the stations, the four most marked cases being those of the observatories at Dehra Dun, Ajmer, Jaipur, and Salem. At each of these four stations the 8 A. M. pressures are somewhat too high. The explanation given by Sir John Eliot is that these observatories are more or less completely shut in by hills of considerable elevation, which diminish the horizontal air movement, and thus give a somewhat higher air pressure during the morning than there would be in the case of free air movement. The effect is purely topographic. In the cases of Ajmer, Salem, and Dehra Dun, which are almost completely shut in, the excess of pressure averages about .02 ins. At Jaipur, which is less completely surrounded, it is about .010 ins.

R. DE C. W.

THE GERMAN RAILROAD IN SHANTUNG.—This railroad, from the port of Tsing-tao on Kiao-chau bay across Shantung province, China, to the large city of Tsinan-fu, on the Hoang River, will be completed before June 1 next. Four-fifths of the line is now in operation. On September 1 last the road was completed to Chou-tsun, 196 miles from its starting-point. This city of about 50,000 inhabitants has a great trade, and is the emporium of the silk trade of Shantung. The city of Tsinan-fu, to which trains will be running next summer, is the capital of Shantung, and has over 300,000 inhabitants. The commercial routes centering at this great mart extend in all directions and as far away as Peking, Hankow, and Shanghai. The railroad passes through the heart of Shantung, which, according to the Chinese census, taken last year, is the most densely-peopled part of the empire.

GENERAL.

BRITISH RAINFALL ORGANIZATION.—The retirement, on August 31st last, of Mr. H. Sowerby Wallis from partial charge of the British Rainfall Organization, and the succession of Dr. Hugh Robert Mill to the sole responsibility, makes this time a suitable one for a brief historical note concerning this interesting meteorological service, which was the crowning achievement of the life of the late Mr. George J. Symons. In the year 1859, when Mr. Symons was twenty years old, he began collecting records of rainfall,

and although this did not form a part of his official work for the Meteorological Office, which he joined in 1860, he sent out, late in that year, a circular letter to all the observers of whom he knew in England, stating that he proposed to collect all the published and unpublished observations of rainfall. Mr. Symons's publication was begun in 1860, when "English Rainfall" appeared, containing the observations made at 168 stations. In the following year the publication contained data for both 1860 and 1861, and was entitled "British Rainfall," as it has remained ever since, the number of stations being 360 in England, 11 in Wales, 115 in Scotland, and 21 in Ireland—a total of 507.

In 1863, Mr. Symons left the Meteorological Office to devote himself exclusively to his chosen task, the expense of collecting and publishing being borne by himself alone at the start, but later being shared, in increasing proportion, by the observers and by Mr. Symons's own friends. In ten years the number of stations was 1,500, and the work required all of Mr. Symons's time for nearly five months of each year. The scope of the work had become national in every sense, but Mr. Symons preferred to continue it as a private enterprise, without State aid, feeling that unless this assistance were given without hampering conditions he could carry on his investigations better by himself.

In 1872, Mr. H. Sowerby Wallis became associated in the work, and continued his connection with the organization until his resignation on August 31 last.

In 1890, the number of stations included in the annual volume was 3,000, and the name of Mr. Wallis appeared with that of Mr. Symons on the title-page of "British Rainfall." In March, 1900, after the sudden death of Mr. Symons, Mr. Wallis assumed the entire charge of the work, and this responsibility, together with the vast amount of detail occasioned by the settlement of the estate and the transfer of the Symons Library to the Royal Meteorological Society, and the ill-health from which he suffered, made it necessary for him to give up his arduous labours. Dr. Hugh Robert Mill, whose name is well known to geographers, and who has been associated with Mr. Wallis for the past three years, has now succeeded him as head of the British Rainfall Organization. Dr. Mill has acquired the historic "rainfall house" of Mr. Symons at 62 Camden Square, London, N. W., and all the rainfall records and instruments there. The organization of which Dr. Mill has control is absolutely unique in its character of a national meteorological service conducted as a private enterprise, without Government aid.

This Organization has already done a most important work for British Meteorology and Climatology. That in the future, under its new head, it will continue and extend its useful labours no one who knows Dr. Mill's capacity can doubt.

R. DeC. W.

Variations of Glaciers.—Each year the International Committee on Glaciers, appointed by the International Geological Congress, makes a report upon the recorded variations in glaciers throughout the world. The summary of the 6th annual report, written by Dr. H. F. Reid, has appeared in the Journal of Geology (Vol. XI, 1903, 285–288). One of the most striking features of these reports is the fact that, in general, glaciers are retreating at their margins. Of ninety-four Swiss glaciers, only one, the Boveyre in the Valais, was found to be advancing in 1901. This glacier, which has advanced 108 metres in ten years, is doing so because of an avalanche which has increased its thickness and length. The greater number of the fifty-five glaciers in the eastern Alps are also retreating, though a few, especially the Vernagt, are advancing; this glacier having gained 50 metres since 1900. All glaciers observed in the Italian Alps are retreating, and retreat is noticed also in the French Alps, Scandinavian mountains, and the Caucasus. Retreat is indicated in the Alaskan glaciers, and some interesting facts concerning these glaciers are stated. Observations indicate a general retreat of glaciers in the Rocky and Sierra Nevada Mountains.

The facts thus gathered and tabulated have not been recorded long enough to admit of general conclusions; but it is evident that this work is a very important one, and that in time the records will give material of great value in considering the nature and causes of fluctuations of glaciers throughout the world. The committee or any one of its members (for example, Dr. H. F. Reid, Johns Hopkins University, Baltimore, Md.) will be very glad indeed to receive any information concerning the changes in glaciers in any part of the world.

R. S. T.

Blood Counts at High Altitudes.—One of the effects of the decreased pressure which is met with at increasing altitudes above sea-level is a change in the composition of the blood, both of human beings and of animals, as has been observed by several investigators. Viault, for example, examined the blood of men and of animals on the Pic du Midi and on the plateaus of Peru, at altitudes of 12,000–14,500 ft., and found a greater amount of haemo-

globin than usual. Viault's own blood contained 5,000,000 red blood corpuscles per cubic millimeter while he was at Lima, and after two weeks at Maracocha, at an altitude of 14,400 ft., the number rose to 7,000,000, and a week later to 8,000,000. The blood of Viault's companions showed similar changes, while in the case of animals taken from the lowlands to the plateau the increase was in the ratio of 4.8 to 7.0. Müntz found about the same ratio in the case of rabbits taken onto the Pic du Midi. On descending to the lowlands, this increased amount of haemoglobin in the blood is lost. Similar investigations have been made by Bert, Egli-Sinclair, Egger, and others, the general feeling being that the increased number of red corpuscles is needed to enable the blood to absorb sufficient oxygen from the rarefied air.

A recent study of blood counts at high altitudes has been made in this country by John Weinzirl, M.S., and C. E. Magnusson, Ph.D., and the results have been published in Nos. 7 and 8 of the *Bulletin of the Hadley Climatological Laboratory* of the University of New Mexico. A grant from the Elizabeth Thompson Fund aided the research. The first paper deals with "Cold as a Causal Factor in the Blood Changes due to High Altitudes," and the second with "Further Observations on Increased Blood Counts due to High Altitudes." The authors of these papers have made numbers of blood counts in the cases of human beings and of rabbits taken to high altitudes, and they conclude that cold is an important factor, though not the only one, in producing the observed changes in the blood. The increase in the number of red corpuscles they find, as others have already found, to be temporary, and this they believe is also due to the change in temperature and not to the change in pressure. R. DeC. W.

Concretions as Elements in determining Land Forms.—Among the geological phenomena that have attracted widespread attention from time long antedating the beginnings of geology as a science is the concretion.

The weird and fantastic forms which concretions at times assume early led to attempts at their explanation. Recently Todd (Bull. Geol. Soc. Amer. XIV, 1903, pp. 353–368) has discussed their origin and stated many facts concerning them, presenting also several plates of illustrations. One of the important parts of his paper is that in which he shows that concretions, where abundant, are of importance in influencing the rate of denudation, and, therefore, in determining the form of the land surface. Being more

finely cemented than the rock in which they have developed, they are more resistant to denudation. Therefore they serve to protect the rock in which they are enclosed. Certain pinnacles in Bad Land regions, and certain buttes and knobs, are thus explained as the result of the protection of one part by the presence of concretions, while denudation has removed less protected rock round about. It would be interesting to apply Todd's suggestions to a given region of abundant concretions in order to determine the measure of importance of this element of influence in land sculpture.

R. S. T.

HUMAN BONES FOUND NEAR GALVESTON.

A LETTER COMMUNICATED BY MR. JAMES DOUGLAS.

OCTOBER 12TH, 1903.

DR. JAMES DOUGLAS, President,
El Paso & Southwestern R.R. Co.,
99 John St., New York City, N. Y.

DEAR SIR:—

Complying with your request to furnish you the data relative to the human bones found in the ballast pits of the Galveston, La Porte & Houston Ry. (now part of Southern Pacific) near Galveston, Texas, I beg to say:

The ballast pits are situated at the mouth of Clear Creek about 32 miles southeast of Houston, Texas, and 25 miles from Galveston, and lie between the creek and the Bay. Originally they covered about 20 acres, and rose to an elevation of 18 or 20 feet above mean low tide. The deposit consisted of about 50% shell of various kinds, oyster, clam, etc., 40% gravel and 10% coarse sand. The whole deposit was covered with about eight inches of soil, and had a dense growth of live-oak trees, some of which seemed very old. The deposit was in seven distinct strata, averaging about 2½ ft. in thickness, with about two inches of black earth between.

All the strata were very much the same, except the bottom one and the second one from the top. These two had very little gravel in them, and consisted of oyster shells (larger than in the other strata) and black earth, and it was in these two "veins" that we found the human bones, one "layer" of bones a little over three feet below the surface, and the other at sea level about twenty feet below surface.

We found very few bones in the upper stratum—probably ten per cent. of the whole—the greater majority being at about the present sea level.

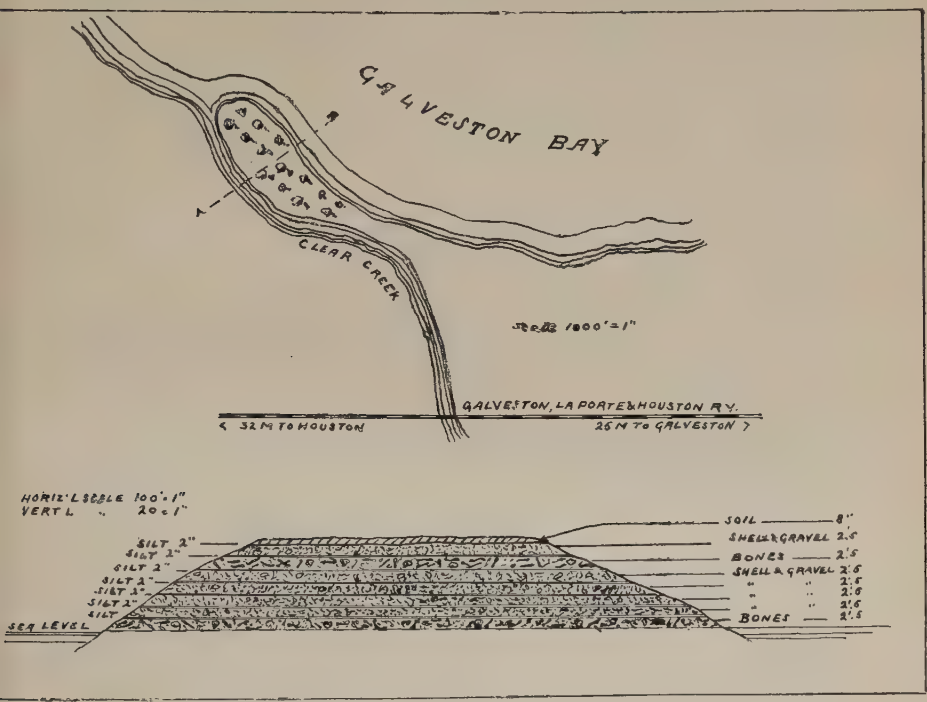
No accurate count of the total number found was kept, but over fifteen hundred were actually tallied, and a conservative estimate would be five thousand.

At first the gravel was loaded by hand, and during this period the foreman counted the skulls, but, later on, a steam shovel was put to work, and after that no count was attempted, though the bones were uncovered daily until the entire pit was worked out.

We usually found two or more skeletons together, and, in one instance, found fourteen, all practically touching.

They were, of course, in no regular order, but were in every conceivable position. When first exposed the bones were wet and soft, but after drying in the sun would be fairly hard and firm. After the steam shovel was put to work, practically all bones were broken when they got to the surface. Some of the skulls were of enormous size, and all had very low foreheads. All seemed to be adults, and one noticeable feature was the almost perfect condition of the teeth, which showed absolutely no sign of decay.

Several broken pieces of pottery were found, also some presumably ivory beads,



about 1½ inches long, with a hole lengthwise through the centre and a diagonal groove on the outside.

Some of these bones were sent to the Pan-American Exposition at Buffalo some years ago.

The last of this shell deposit was removed during the Summer of 1896.

I attach a small sketch, made from memory, showing approximately the location of the ground and the arrangement of the strata.

Yours respectfully,

(Signed) H. J. SIMMONS,

General Superintendent.

NEW MAPS.

AMERICA.

UNITED STATES.—Map of the State of New York. Scale, 12 statute miles to an inch. Frederick J. H. Merrill, State Geologist, State Museum *Annual Report*, 1901, Albany, 1903.

This excellent map shows the surface features and watersheds of New York State. Brown tints are used to emphasize the contours, which are drawn on the coast at intervals of 50 and in the interior at intervals of 200 feet. Green lines form the boundaries of the several drainage basins. The map represents admirably the broader generalizations as to the topography and drainage of the State. The elevation of nearly all the lake surfaces is given.

UNITED STATES.—State of North Dakota. Scale, 1:760,320, or 12 statute miles to an inch. Compiled under the direction of Frank Bond, General Land Office, Washington, D. C., 1903.

CANADA.—Alberta and Western Portions of Saskatchewan and Assiniboia. Scale, 1:792,000, or twelve and one-half statute miles to an inch. James White, Geographer, Department of the Interior, Ottawa, 1903.

A land office map showing the location of the land offices, names and outlines of the land districts and the extent of the land surveys, which have been so far completed in Alberta as well as in Assiniboia that claims may be taken up in most parts of those provinces.

CANADA.—Topographic map of the Rocky Mountains. Banff and Lake Louise sheets. Scale, 1:127,000, or two statute miles to an inch. Department of the Interior, Ottawa, 1902.

These maps, with a contour interval of 250 feet, include the Rocky Mountains Park of Canada and areas to the west around Lake Louise, Kicking Horse Pass and Mt. Stephen, showing the route of the Canadian Pacific railroad from its entrance into the mountains as far west as Palliser.

CANADA.—Map of the Yukon District, with the adjacent northern part of British Columbia. Scale, 1:750,000, or 11.84 statute miles to an inch. Department of the Interior, Ottawa, 1903.

The map shows the railroad from Skagway, which was completed in 1900 to Whitehouse, about twenty miles south of Lake Laberge; the distance of the terminus from Skagway is about 90 miles in a straight line. At Whitehouse passengers and freight cars are transferred to a stern wheel steamer plying to Dawson. A Klondike railroad extends about twelve miles between Dawson and Grand Forks at the junction of Sulphur and Eldorado Creeks. The heights of many elevations are given.

PATAGONIA.—Fondeadero Atlas. Bahia Vera. Scale 1:20,000, or 0.3 statute miles to an inch. Hydrographic Office, Buenos Aires, 1901.

This sheet is one of the first charts published by the Hydrographic Office of the Argentine Government, organized not long ago. This office is surveying anchorage and landing-places along the east coast of Patagonia at points favourable for colonization. The area chartered on this sheet is south of the Chubut River. Many soundings are given and details of the coast are clearly drawn.

EUROPE.

AUSTRIA-HUNGARY. Autriche-Hongrie. Les Races. Scale, about 138 statute miles to an inch. By René Henry. *Revue de Géographie*, Paris, October, 1903.

The map shows in five colours the distribution of Slavs, Germans, Rumanians, and Italians in the Austria-Hungarian empire and illustrates a paper by Mr. Henry.

GERMANY. Die landwirtschaftlichen Hauptbetriebe in Preussen, 1895. Scale, 1:2,750,000, or 43.5 statute miles to an inch. *Zeitschrift* of the Royal Prussian Statistical Bureau. Berlin, 1903.

The map gives a minute idea of the differing degrees of intensity of agriculture throughout Prussia.

GERMANY. Übersichtskarte über das Nordschleswigsche Wattenmeer und die Bodenverhältnisse des Landgebietes. Scale, 1:300,000, or 4.73 statute miles to an inch. By E. Moritz. *Mitteilungen der Geographischen Gesellschaft in Hamburg.* Vol. XIX. Hamburg, 1903.

The map shows the sand banks and mud flats which are exposed at low water along the coast of north Schleswig; and the geology of the neighbouring coasts and islands.

ASIA.

INDO-CHINA. Projets d'Irrigation dans le Delta du Fleuve Rouge. Scale, 2:500,000, or 7.8 statute miles to an inch. *Annales de Géographie*, No, 66. Librairie Armand Colin, Paris, 1903,

Showing the drainage and irrigation works completed, in progress, or projected in the delta of the Red River.

INDO-CHINA. Réseau des grandes voies navigables de la Cochinchine et du Cambodge. Scale, 1:1,000,000, or 15.7 statute miles to an inch. *Annales de Géographie*, No. 66, Librairie Armand Colin, Paris, 1903.

The navigable waterways and the extent to which they are utilized by various lines of vessels are indicated; also the canals which are to connect the various waterways.

TIBET. Professor Dr. Karl Futterers Routen-Aufnahme vom Küke-nur durch nordost-Tibet bis Min-Tschôu, sheets I and II. Scale, 1:500,000, or 7.8 statute miles to an inch. By Dr. Hassenstein and C. Schmidt. Gotha, Justus Perthes, 1903.

The map illustrates Dr. Futterer's "Geographische Skizze von nordost Tibet," published by J. Perthes as *Ergänzungsheft* No. 143 to *Petermanns Mitteilungen.* The journey occupied from Aug. 11 to Nov. 29, 1898. All important detail which could be observed from the line of travel is indicated. Photographic surveys were helpful in drawing the map.

AFRICA.

CONGO INDEPENDENT STATE. Carte du Katanga. Scale, 1:1,000,000, or 15.78 statute miles to an inch. By H. Droogmans, Financial Secretary-General of the Congo Independent State. Brussels, 1903.

Katanga is the southeastern part of the Congo State. This vast region is administered by the Special Committee of Katanga, whose agents have been exceedingly active in its exploration, with the result that parts of the country have been proved to be highly mineralized or rich in rubber. This black-and-white map is a collection of

material supplied by these explorers, including Capt. Charles Lemaire, who astronomically determined the position of many points in Katanga, especially in the south and along the west shore of Lake Tanganyika. The map is largely based upon these determinations. The comparatively large scale makes it possible to insert many itineraries and place-names, to indicate hill features and very many waterways.

UGANDA PROTECTORATE.—Three maps. Scale, 1:2,220,750, or 32 statute miles to an inch. Reports of the Sleeping Sickness Commission No. II. Harrison & Sons, 1903.

The first of these maps illustrates, in shades of brown, the distribution of sleeping sickness around the northern part of Victoria Nyanza up to Oct. 23, 1902; the second, the distribution of *Filaria Perstans*, an animal parasite, in Uganda; and the third, the distribution of banana culture and clothed people in Uganda. Nos. III and IV of the Reports contain later maps showing the revised distribution of the disease in Uganda; and No. IV a map showing the distribution of *Glossina Palpalis* in Uganda. The distribution of Sleeping Sickness and *Glossina Palpalis* correspond. It has been ascertained that the disease is caused by the entrance into the blood and cerebro-spinal fluid of a species of trypanosoma; that the trypanosomes are transmitted from the sick to the healthy only by the *Glossina Palpalis*, a species of tsetse fly; in other words, sleeping sickness is a human tsetse fly disease.

MADAGASCAR.—Völkerkarte von Madagaskar. Scale, 1:12,000,000, or 189.3 statute miles to an inch. *Deutsche Rundschau für Geographie und Statistik.* Vol. XXVI, No. 2, November, 1903. A. Hartleben, Vienna.

Showing in colours the distribution of the various peoples of Madagascar, with the subdivisions of the Sakalava. The inland areas that are very thinly populated are left uncoloured.

OCEANIA.

AUSTRALIA.—Approximate route of the proposed Transcontinental Railway from Oodnatta to Pine Creek. Scale, 1:6,336,000, or 100 statute miles to an inch. Surveyor General's Office, Adelaide, South Australia, 1902.

This sketch map appears in the pamphlet on the proposed "Land-Grant Railway across Central Australia" from Adelaide to Port Darwin, issued by the Government of South Australia in 1902. The figures of average rainfall for a series of years, laid down at eleven points through the so-called desert of inner Australia, show a larger precipitation than this region has usually been credited with; and many areas of grass are indicated.

QUEENSLAND.—Geological Sketch Map of Queensland. Scale, 1:2,534,400, or 40 statute miles to an inch. By B. Dunstan and H. W. Fox. Geological Survey of Queensland. Brisbane, 1902.

In addition to the geological formations shown in colours the map indicates the position of the gold, coal, opal, and other mineral fields in the state.

POLAR.

NOVAYA ZEMLIA.—Borissows Aufnahmen in Nowaja Semlja im Winter, 1901–2. Scale, 1:300,000, or 4.7 statute miles to an inch. *Petermanns Mitteilungen*, Vol. 49, No. 10, 1903. Gotha.

Three maps on one sheet showing the results of surveys by the Russian artist Borissov, of three deep, narrow bays or fiords (Tsekin, Rasmyslov, and Medweshji Bays), on the east coast of Novaya Zemlia, of which only Tsekin Bay has hitherto been indicated on the maps.

THE WORLD.

World.—Das Kabelnetz der Erde. Mercator Projection. Equatorial scale, 1:85,000,000. *Deutsche Rundschau für Geographie und Statistik.* Vol. XXVI, No. 1, October, 1903. A. Hartleben, Vienna.

An excellent map, distinguishing in colours the British, American, French, Danish, German, and other cable lines, and also showing the projected lines and the chief lines of land telegraph.

World.—Die abflusslosen Gebiete der Erde. Hemispheres. Vertical-Horizontal Projection. *Deutsche Rundschau für Geographie und Statistik.* Vol. 26, No. 3 Vienna, 1903.

Showing the areas of interior drainage and illustrating an article on this subject by Mr. W. Henz.

ATLASES.

Denmark.—Lomme-Atlas over Denmark. 7¼ by 4¼ inches. Copenhagen, Vilhelm Prior. 1902.

A pocket atlas containing twenty coloured maps, of which sixteen are given to Denmark and four to the colonies. The scale of the Denmark sheets is uniformly 1:420,000, or 6.6 statute miles to an inch, which is large enough to include practically all the place-names and show in addition the distribution of sand, marsh, timber, hill features and other aspects of the country. The map of Greenland is not extended far enough up the east coast to show Angmagsalik, the chief settlement on that coast.

Atlas Universel de Geographie.—Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. No. 16-Péninsule Ibérique; scale, 1:2,500,000, or 39.4 statute miles to an inch. No. 49-Asie en 10 feuilles (feuille IV, Japon, Corée, Mandjourie); scale, 1:5,000,000, or 78.9 statute miles to an inch. No. 64-Afrique Française en 3 feuilles (feuille I, Afrique Occidentale Française); scale 1:5,000,000, or 78.9 statute miles to an inch. Librairie Hachette et Cie, Paris, 1903.

The sheet Japan, Corea, Manchuria (zenithal-equidistant projection) is on a larger scale than most atlas sheets of this region, and is engraved in the superior style characteristic of this atlas. What is known of the topography is sharply and clearly defined. On the sheet French West Africa, the numerous surveys of the French Military Geographic Service and of other explorers for the past ten years have been utilized, and the resulting product on the whole is the best atlas map of this region that has yet appeared.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, NOV. 19, 1903.

The organization of the *voirie vicinale*, charged with the supervision of the district roads, dates from the year 1836, when the map of France, known as the map of the General Staff, was already well under way. With the needs created by the establishment of the great railways, the network of the communal roads extended until it covered the whole country with a system which is still in process of development.

The local administrations undertook, at an early day, to construct road-maps for immediate use, but without concerted action or reference to any general plan. It was evident to those who inspected the collection of these maps on exhibition at the Ministry of the Interior in 1878 that there was but one remedy for this state of things—to construct a map of the whole of France, according to a single plan, and on one scale.

The Ministry of the Interior determined to undertake this work and to bring out a map which should constitute a sort of dictionary of the highways and the paths of the country. A plan, devised by a Special Commission, received the approval of the Parliament, and the Ministry entered upon its task. The first sheets of this map appeared in 1879, and in 1896 the work was completed with the publication of the 587th sheet.

Of explorations there is something to report. In Africa, M. E. F. Gautier has visited a portion of the Muydir plateau and the whole of the Adrar Ahnet, and has pushed on to In-Zize, almost midway to Timbuktu; a point previously reached by none but Laing, about eighty years ago.

At In-Zize, M. Gautier discovered a number of inscriptions in Targui characters*, and some rock drawings (evidently later than the Seventh Century, since they include the camel), and offering in their careful style a contrast with the summary drawings of the same epoch from southern Oran. The region is extremely arid and uninhabitable.

Very different is the country of Portuguese Guinea travelled by the Franco-Portuguese Boundary Commission, which has traced the course of the Rio Grande and the Componi, and assigned to

* The alphabet of the Tuareg.

France the territory of Kadé. There remains to be settled the southern frontier of Cazamance, and when this is done it will be possible to issue exact maps of a West African district still very little known.

A similar work of delimitation has been performed by the Anglo-French Commission on the frontier of the Ivory and the Gold Coasts, from Nugua (on the Tanoe) to Bonduku, and from Bonduku to Tampuri (11° north latitude). The map, on a scale of 1:250,000, is based on 2 determinations of longitude and 49 of latitude.

To the north of this region, Lieut. de Franco, in five years' exploration in the bend of the Niger, has accumulated a series of itineraries of the greatest value. His work outside of the bend of the Niger has already been utilized in Lieut. Chédeville's map of the Third Military Territory.

A letter from Capt. Lenfant, published in *La Géographie*, shows that at the end of August he cherished the hope of finding a waterway to Logone, notwithstanding the contradictory statements gathered on his march.

In the West, Lieut. Faure is exploring the Tuburi depression, in order to furnish information to Capt. Lenfant for this portion of his journey. In Eastern Africa, M. Charles Alluaud has made a zoological exploration from Mombasa to the shores of the Victoria Nyanza, and M. d'Ollone is on his way to Harrar.

In Asia, M. Martel is actively at work in the Caucasus. Capt. Cros, of the French Chaldean Expedition, has surveyed with the Peigné compass, and, barometrically, a complete itinerary from Damascus to Bagdad, joining the line of the railroad at Filudja, on the Euphrates. His map is on a scale of 1:100,000.

A letter from Lieut. Grillières, published in *La Géographie* for September, announces his success in tracing the Pu-tu-Ho, the Blue River, and the Niu-Lan-Kiang, which he ascended to its source, opposite Yang-Ling, across a country of which the very roughest districts of the Alps barely give an idea. He laid down his route on a scale of 1:50,000. His plan was to reach the frontier of Tibet and enter that land by the valley of the Salwen.

M. Gervais-Courtellemont, who lately returned from a journey of eighteen months in Yunnan and Tibet, reports having explored and mapped the bend of the Yang-tse. He has not yet published the account of his journey, but he has exhibited at the Galérie d'Orleans a display of the principal productions of the region and the kinds of merchandise for which it offers a market.

M. Bordat writes that in New Caledonia an exploring expedition

is about to start for the island of Espiritu Santo, in the New Hebrides.

In South America, M. Eugène Robuchon has left Iquitos, to ascend the River Putumayo as far as possible, and then to cross by land to the Napo and return to Iquitos—a journey which should furnish interesting comparisons with that of the regretted Dr. Crevaux in 1879.*

Dr. Neveu Lemaire, of the Scientific Mission to Peru and Bolivia, made in June a study of Lake Poopo (Aullagas).

In company with Prof. Julien Thoulet, Dr. J. Richard, and other men of science, the Prince of Monaco, during his last oceanographic excursion, made a study of the deep-sea circulation at a distance from the French coasts. He took soundings to the depth of 4,835 metres (15,863 feet) and made fine collections, geological and planktonic, though unfavourable weather defeated his proposed investigation of the migrations of the sardine. One of his collaborators, Lieut. Sauerwein, has employed in hydrographic operations the *tachéographe* of M. Frantz Schrader, which traces automatically horizontal distances and differences of level. With the help of this instrument M. Sauerwein has executed a plan of the Mediterranean coasts around Monaco, and as far as the Italian frontier, gathering systematically samples of the bottom, and laying down on his map from the study of these the geology of the sea-bed.

Some of the publications, mentioned only by title in preceding letters, may now be considered at greater length to advantage.

Geographers devote themselves, perhaps too exclusively, to the study of the surface of the soil, with but rare allusions to the succession of materials in depth, and to the tectonic arrangement; as if they studied the façade to the neglect of the architecture. This method is declared by Commandant Barré, in the introduction to the *Architecture du Sol de la France*, to be no longer admissible. His previous studies (on the Region of the North-East, on the Forest of Fontainebleau, on the Upper Valley of the Saône) had prepared him for the composition of this instructive volume. Here are brought together, arranged on a general plan and harmonized with each other, the different elements which geology supplies to geographers for the description of France. Every page of the book

* The atlas of *Fleuves de l'Amérique du Sud*, published in 1883 by the Société de Géographie, contains 12 plates which show the course of the Iça (Putumayo); constructed on the scale of 1:200,000 by M. J. Hansen from the MS. surveys of Dr. Crevaux.

shows how the structure of the soil makes the law for the movement of the waters, as well for the fainter slopes as for the most abrupt elevations, and regulates the disposition of the rock masses, forcing the sculpture of the soil to take account of the oldest forms, as well as the latest. Besides numerous sketches and geological sections, the work is illustrated by outline perspectives, which distinguish very clearly the different compartments of the soil. No doubt, we must regard Commandant Barré's volume as an essay to be modified in many respects hereafter, but none the less it enforces the lesson that the map must be read not only as a plan, but also as representing depth, and even duration of time.

Naturally allied to this work is the *Tableau de la Géographie de la France*, written by M. P. Vidal de la Blache, as an Introduction to the great History of France from the Earliest Times to the Revolution, edited by M. E. Lavisse.

M. de la Blache has taken especial pains to bring out the relation between the soil in its present aspect and its composition and geological history. We must not fear, he says, that we shall in this way disturb the impression created by the lines of the landscape, the forms of relief, the contour of the horizon, and the outward aspect of things. On the contrary, the comprehension of the causes enables us to appreciate more justly the resulting harmonious arrangement. In the first part of his admirable work M. de la Blache has shown how a portion of the earth which is neither peninsula nor island, nor properly to be regarded as a whole in physical geography, has developed into a political country and become at last a fatherland. In the second part, *Regional Description*, the physiognomy of France is presented under all its various aspects. The text is illustrated by various excellent maps.

Works such as those of MM. Barré and de la Blache are not to be produced until a country is in possession of exact and detailed topographical maps like the maps of France on the scale of 1 : 80,000, recently described in these pages. Col. Berthaut, head of the Cartographical Section in the *Service Géographique de l'Armée*, has lately published a book on the Military Geographical Engineers, the precursors of the officers to whom is due the execution of the map known as that of the General Staff, and fully described in all its details in an earlier work by the same author.

The volume just issued relates the history of the tasks accomplished by the military geographical engineers in countries outside of France.

It may, perhaps, be said that Col. Berthaut has passed too

lightly over the work done in the 18th Century beyond the boundaries of Europe; but his book tells a great part of the history of French geography for two centuries (from 1624 to 1831).

It contains reproductions in facsimile of numerous manuscripts and engraved maps, French and foreign, which constitute a veritable album of the changes effected in the methods of representing surface and relief in cartography.

The last work to be noticed is rather anthropological and ethnographic than geographical, though its value to students of geography is beyond question. This is Dr. Verneau's book on the Ancient Patagonians, a contribution, as he calls it, to the study of the Pre-Columbian races of South America. From the study of the collections brought by Dr. Machon from the Rio Negro and the Chubut, of those in the *Muséum d'Histoire Naturelle* and the Anthropological Society and those gathered in Patagonia by Comte Henry de la Vaulx, Dr. Verneau has satisfied himself that the most southern portion of the American continent was peopled in ancient times by many and various groups: *platy-dolichocephalic*, *hypsi-dolichocephalic*, *platy-brachycephalic*, *sus-brachycephalic*, besides the Araucanian type and another, also of small stature but extremely robust, and three others which deformed the skull in fashions differing from the practices in vogue among the Tehuelches and the platy-brachycephalic types. The peopling of the southern parts of America was effected by migration. The two ethnic groups, numerically the most important, are closely allied to the ancient races, the bones of which are found in the Brazilian caverns; others descended from the table-lands of the Andes and even from the Pacific slope. In Patagonia these various elements underwent a certain degree of amalgamation, but the original differences never entirely disappeared. In the absence of history and traditions, anthropology enables us to recognize very distinct races in the relics collected by explorers from the old burying-places and to throw some light upon a chaos which seemed, at first sight, to be inextricable.

These are the conclusions of a work conducted with absolutely correct method and science and exact in every detail. The International Jury of the L. Angrand Foundation has unanimously awarded to Dr. Verneau the prize in American History and Archæology.

HENRI FROIDEVAUX.

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Geography of Commerce, by Spencer Trotter, New York, The Macmillan Co., 1903, 8vo [*Maps and illustrations*]; Pleasure-Book of Grindelwald, by Daniel P.

Rhodes, *with many illustrations*, New York, The Macmillan Co., 1903, 8vo; History of Coinage and Currency in the United States and the Perennial Contest for Sound Money, by A. Barton Hepburn, New York, The Macmillan Co., 1903, 8vo.

From Francis C. Nicholas, M. Sc., Ph.D., New York, Author:

Around the Caribbean and Across Panama. *With maps, etc.* Boston and New York, H. M. Caldwell Company (1903). 8vo.

From the Department of the Interior, Ottawa, Canada:

MAP of Alberta and Western Portions of Saskatchewan and Assiniboia, 1903, *scale:* 12½ miles = 1 inch, *size:* 25 x 35 inches; BANFF Sheet and Lake Louise Sheet of the Topographical Map of the Rocky Mountains, *scale:* 2 miles to 1 inch, 1902, *size:* Banff Sheet, 18½ x 13⅝, Lake Louise Sheet, 19¾ x 17 inches; MAP of Yukon District with the adjacent Northern Part of British Columbia, 1903, *scale:* 11.84 miles = 1 inch, *size:* 28 x 39½ inches.

From Paul Parey, Publisher, Berlin:

Die geographische Verteilung der Getreidepreise in den Vereinigten Staaten von 1862 bis 1900. Von Th. H. Engelbrecht. Mit 24 Kärtchen auf 8 Tafeln. Berlin, Paul Parey, 1903. 8vo.

From Carl Ernst Poeschel, Publisher, Leipzig:

Grundzüge der Handels- und Verkehrsgeographie, von Dr. Emil Deckert. 3te Auflage. Leipzig, Verlag von Carl Ernst Poeschel, 1902. 8vo.

From G. P. Putnam's Sons, New York:

Danish Life in Town and Country. By Jesse Brochner. Illustrated. New York and London, G. P. Putnam's Sons, 1903. 12mo.

From Miss Ellen Churchill Semple, Author, Louisville, Ky.:

American History and its Geographic Conditions. Boston and New York, Houghton, Mifflin & Co., 1903. 8vo.

From W. D. Scott, Superintendent of Immigration, Ottawa, Canada:

The Canadian Year-Book for 1903. Toronto, Canada, Alfred Hewett, 1903. 8vo.

From Franz Siemenroth, Berlin:

Brasilien und seine Bedeutung für Deutschlands Handel und Industrie. Von Dr. Walther Kundt. Berlin, Franz Siemenroth, 1903. 8vo.

From Wilhelm Süsserott, Berlin:

Wie rüste ich mich für die Tropenkolonien aus? Von Ernst Tappenbeck. Berlin, W. Süsserott, 1903. 8vo.

From Prof. Ralph S. Tarr, Author, Ithaca, N. Y.:

Postglacial and Interglacial (?) Changes of Level at Cape Ann, Massachusetts. With a Note on the Elevated Beaches by J. B. Woodworth. *Bulletin of the Museum of Comparative Zoölogy at Harvard College, Vol. XLII, Geol. Series, Vol. VI, No. 4.* Cambridge, Mass., 1903. p., 8vo.

From B. G. Teubner, Publisher, Leipzig:

Aus Deutsch-Brasilien. Von Alfred Funke. Leipzig, B. G. Teubner, 1902. Square 8vo. [*Map and illustrations.*]

From the Department of State, Washington:

Alaskan Boundary Tribunal: The Case of the United States; The Argument of the United States; The Counter-case of the United States. *With two accompanying Atlases.* 3 vols. 8vo, 2 vols. folio. Washington, Government Printing Office, 1903.

From N. H. Winchell, Author, Minneapolis:

Pleistocene Geology of the Concannon Farm, near Lansing, Kansas. *From the American Geologist, May, 1902.* p., 8vo.

OBITUARY.

Rear-Admiral Bancroft Gherardi, U. S. N.

Born at Jackson, Louisiana, November 10, 1832.
Died at Stratford, Connecticut, December 10, 1903.

Bancroft Gherardi was a nephew of George Bancroft, the historian, under whom, as Secretary of the Navy, the Naval Academy was established at Annapolis in 1845. Young Gherardi entered the navy as a midshipman in 1846 and served on the *Ohio* of the Pacific squadron until 1850, when he entered the Naval Academy and was promoted to Passed Midshipman in 1852. He was then ordered to the *St. Louis*, on the European station, and after some years to the Home squadron. In 1858 he was navigating officer of the *Niagara* when that ship was employed in laying the first Atlantic cable.

In the Civil War he was commissioned as Lieutenant-Commander in 1862, took part in the attack on Fort Macon, and served in the West Gulf blockading squadron. In command of the *Port Royal*, of that squadron, he fought in the battle of Mobile Bay, in which his ship was so badly damaged that she was laid up for repairs and Lieut. Gherardi was transferred to the command of the *Pequot*, of the North Atlantic blockading fleet.

In 1866 he was made Commander, Captain in 1874, Commodore in 1884, and Rear-Admiral in 1887. During these twenty-one years he was constantly on duty on the home station or abroad. His sea-service ended in 1892, when he arrived at Hampton Roads with the Pacific squadron and took command of all the United States ships assembled for the great review in commemoration of the fourth centenary of the Discovery. The same year he was placed in charge of the New York Navy Yard, and there remained until retired from active service in 1894.

He became a Fellow of the American Geographical Society in 1894 and a Councillor in 1895. Failing health compelled him to resign his seat in the Council in 1902.

Admiral Gherardi's manly and amiable character won the respect and the affection of all who were brought into close relation with him.

TRANSACTIONS OF THE SOCIETY.

NOVEMBER–DECEMBER, 1903.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, November 17, 1903, at 8.30 o'clock P.M.

In the absence of a presiding officer, the meeting was opened by the Librarian.

The following persons, recommended by the Council, were duly elected Fellows by vote of the Society:

Evans R. Dick.
Simon Guggenheim.
Daniel Bacon.
Henry A. Lloyd.
Alvah D. James.
Edward D. Sniffen.
Gates D. Fahnestock.
James Armstrong.
William Porter Allen.
F. W. Bennett.
Nathan Appleton.
Dr. Willis E. Everette.
J. H. Cuntz.
Richard C. Veit.

Prof. E. L. Stevenson, of Rutgers College, was then introduced. He addressed the Society on Martin Waldseemüller and the Early Lusitano-Germanic Cartography of the New World.

Maps were shown on the screen.

On motion, the Society adjourned.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, December 15, 1903, at 8.30 o'clock P.M.

Vice-President Moore in the chair.

The following persons, recommended by the Council, were elected Fellows:

Edward L. Hale, William J. Burnett, B. Drake-Smith;

and Horace E. Williams, of São Paulo, Brazil, was elected a Corresponding Member.

The Chairman then introduced the speaker of the evening, Dr. Frederick A. Cook, who described his expedition to Alaska and his attempt to make the ascent of Mt. McKinley.

Stereopticon views were shown.

On motion, the Society adjourned.

BOOK NOTICES.

American History and its Geographic Conditions. By Ellen Churchill Semple. Houghton, Mifflin & Co., Boston, 1903. 466 pp., 16 maps.

American History and its Geographic Conditions: Under this rather cumbersome title is included an exceedingly scholarly treatment of the operation of geographic influences in American history. Appearing, as it does, almost simultaneously with Brigham's Geographic Influences in American History (reviewed in this number of the BULLETIN), one naturally compares the two books in order to see how two different authors approach the same general subject. The interest in this comparison becomes still greater because of the fact that these two books are pioneers in a large field destined in the future to be exploited from many points of view. It requires but a cursory examination to discover that the two works are absolutely different, and, moreover, that they really supplement one another. In Professor Brigham's book, as might be expected, the basis is physiographic, and from this basis numerous geographic influences are considered. The very division of the subject by chapters is made on physiographic lines. In Miss Semple's book, on the other hand, the basis is historical, and in the course of the unfolding of the history of the United States it is shown what geographic influences have been in operation.

Starting in Chapter I with the maritime history of Europe, in which the significant facts relating to the discovery and exploration of America are briefly indicated, the author proceeds in Chapter II to a study of the rivers, pointing out their importance in the explorations for the Northwest Passage and as pathways for the fur trade. Not only the large but even the small rivers are considered in this excellent statement of the influence of rivers on early exploration and settlement. The importance of the Appalachian barrier warrants the assignment of two chapters, the first treating of its influence upon colonial history, the second of its influence in the guidance of the westward movements of the pioneers. In the fifth chapter the geographical position of the trans-Allegheny settlements is considered, especial attention being paid to the influence of the Appalachian barrier in separating them from the Coast States, as well as of the Mississippi River as an avenue of trade toward the

Gulf. This naturally leads to a consideration, in Chapter VI, of the Louisiana Purchase, which, as Miss Semple shows, simply anticipated what must eventually have come about as a result of geographic influences, namely, the assembling of the various parts of the Mississippi Valley under one control.

Then follow chapters on the "Geography of the Atlantic Coast in Relation to the Development of American Sea Power"; the "Geography of Sea and Land Operations in the War of 1812"—the best treatment of this topic that the reviewer has seen; and "Spread of Population in the Mississippi Valley as Affected by Geographic Conditions," including a very clear statement of the causes operating toward the separation of Texas from Mexico. Chapters X and XI consider the nature of the movement westward across desert and mountain and clearly show how important the rivers were in guiding these early movements. Strangely, neither here nor elsewhere in the book are the Mormons mentioned. It is, of course, a delicate question to handle, but failure to treat it leaves an important gap in an otherwise complete whole. In this connection it may be said that the general subject of irrigation and its influence seems to have demanded fuller treatment than it receives.

Chapter XII points out clearly the reasons why the United States naturally expanded as it did, becoming a great continental power, and also shows how the surroundings and opportunities have reacted to influence American character. In the next chapter it is shown how important are the inland waterways, how their development by aid of canals was checked by the incoming of railways, and how important it now is to improve them properly by adequate canals. There is in Chapter XIV a vivid picture of the geographic influences operating in the Civil War, especially in the campaign around Richmond. "The Geographical Distribution of Immigration," discussed in Chapter XV, considers the nature and causes of the distribution, and closes with a statement of the turn of tide to immigration out of America into Canada. Chapter XVI, "Geographical Distribution of Cities and Industries," is a broad treatment of general principles, and is one of the least specific in the book. Chapter XVIII discusses the "Geographical Distribution of Railroads."

The entire book is an argument for expansion, and it is evident that Miss Semple's studies have led her to the belief that America's destiny to reach out over the world is a result of the operation of geographical laws. Doubtless, many will not agree to the adequacy of all the reasons she sets forth, or that she has fully taken into

account all causes that are operating. Nevertheless, she makes a strong case, and the book can be recommended to anti-expansionists as one that certainly shows the main arguments of the other side clearly. Especially in the last two chapters—one on "The United States in relation to the American Mediterranean," the other on "The United States as a Pacific Ocean Power"—are the nature and causes of expansion most fully treated. In the first of these it is shown how important it has been to gain a foothold in the West Indies; and this chapter might even be used by President Roosevelt in defence of the Panama policy of the Administration, although written before it was adopted. This chapter also gives a statement of the striking development of commerce in the Gulf region, the drift of trade down the Mississippi, as is natural, and the marked growth of New Orleans. That our expansion across the Pacific is a result of geographic conditions is the burden of the last chapter, in which it is pointed out that our position on two oceans demands a development in each, and that the apparent jump, which has caused so much uneasiness, is merely the logical extension of our entire national policy and development, now taking a somewhat new form when the water frontier is reached. Miss Semple spares the feelings of the Canadians in not making a point of the resemblance between the extension of American influence into Texas and the recently begun movement of Americans into Western Canada. Will her law operate here?

Miss Semple's book will find a wide audience, for it appeals to people of many interests. The time has arrived when educated people in general should know not merely that United States has grown and that it has had a certain history, but why this has been so. This book states these reasons along many lines. Moreover, it states them clearly and convincingly, and evidently upon the basis of wide research and knowledge. It is a marked book, not merely because one of the first of its kind on this subject, but because it is an adequate treatment of the subject.

R. S. T.

*Geographic Influences in American History.**—In preparing this book Professor Brigham has broken a new path, along which others will doubtless follow. The book commands attention not alone because written by an American geographer of high rank, but also because it is the first book to treat scientifically of the intimate

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* *Geographic Influences in American History, by Prof. Albert P. Brigham, 366 pp., Ginn & Co., Boston, Mass.*

relation between physiography and American national development. This is a large subject and a difficult one, for it is on the border line between two comprehensive divisions of knowledge. To cover the ground well, and especially in the small compass of a book of little more than 350 pages, calls not only for extensive knowledge, but also for marked skill in handling the task.

To accomplish his object of presenting a large subject in a small compass the author has centred his description around several large topics of marked importance. His first theme, "The Eastern Gateway of the United States," tells with great clearness the wonderful story of the Mohawk valley and its influence on the development of lines of travel and transportation and the growth of industries and cities. While throughout the book the literary style is excellent and well calculated to hold the interest, this first chapter seems to excel the others in these respects.

The second chapter, entitled "Shore-Line and Hilltop in New England," has a less compact theme, and is consequently more disjointed. It, moreover, enters rather farther into the purely physiographic phases of the subject. But one cannot read this chapter without gaining a realization of the profound influence of physiography on New England life, which, as Brigham shows, impresses itself even on the literature of the best New England writers. It is an excellent characterization of New England conditions and their relation to causes. Not a few New Englanders have not yet, however, schooled themselves to the belief that the future of this section is so economically dark as might be inferred from the author's partial prophecies. It is doubtless true that New England is geographically better fitted to become a summer resort and a producer of building stones than to lead in cotton manufacturing; but the future, like the past, may supply examples of conditions which seem to defy the laws of "geographic control." The decline of New England is much talked of, but is much less a fact than would be inferred from many of the statements about it.

Chapter III presents the clearest and best description of "The Appalachian Barrier" and its effects that the reviewer has seen; and the next chapter, under the title of "The Great Lakes and American Commerce," gives a clear and interesting statement of the importance of the Great Lakes and Niagara. The author's outline of the future possibilities of the lakes, supplemented by proper canals, and his discussion of the possible diversion of trade from the Central States to Southern ports, are full of interest to

New York people at the present time, when the undertaking has been determined upon of endeavouring to provide for the retention of the interior traffic along the natural eastern gateway.

"The Prairie Country" is treated in Chapter V, and "Cotton, Rice, and Corn" in Chapter VI. The latter chapter gives a strong picture of the geographic reasons for believing in a great future for the South, as well as a clear, striking statement of her past as guided by geographic influences. The remaining chapters, each worthy of special comment, bear the following titles: "The Civil War," "Where Little Rain Falls," "Mountain, Mine, and Forest," "From the Golden Gate to Puget Sound," "Geography and American Destiny," and "Government Study of our Domain." The book is illustrated by 72 well-selected pictures, reproduced as half tones, and 16 maps.

While the book aims primarily to show the influence of geographic conditions on the development of a great nation, Professor Brigham again and again makes it clear that he is not so blinded by his own special interest as to think that geographic influences *control*. Yet he falls into the use of the phrase "geographic controls," which comes so easily to some physiographers.

The appearance of Professor Brigham's book is an important event, marking as it does the first organized excursion into this great borderland by an American physiographer. It cannot but have an influence of importance in other directions than in leading the way. It will bring before the geographer a statement of many points of relation of his science to history; and the historian it will remind of what is sometimes overlooked—that there are many geographic factors of value in human development. Teachers in all lines of geography will find the book of value in their work, and so, also, ought the teacher of history. Moreover, the book will be read by many for the mere pleasure of reading a delightfully-written text on a theme of general interest, presented from a new standpoint.

R. S. T.

L'Architecture du Sol de la France, by Commander O. Barré. pp. 111 and 393, with 189 figures and plates. Paris, Armand Colin, 1903.

L'Architecture du Sol de la France is one of the best and most detailed studies of the geomorphology of a large area that has yet appeared. The author has made use of all the modern principles of geomorphology and has applied these principles to a careful and comprehensive study of the development of France. The state-

ments of the text are illustrated by many maps, sections, and perspective drawings, which give a vividness and clearness to the exposition such as the text alone could not give.

The introduction is devoted largely to a summary of the processes of continental growth and development, so familiar to all who have followed the work of Davis, Gilbert, Hayes, de Margerie, and others within the last decade and a half. Following these general matters the author has inserted a brief summary of the geographical history of Europe, in which he has incorporated a number of maps showing the outline and extent of the continent during the several geological periods. He further divides the existing highlands of Europe into two groups according to whether their general form is tabular or folded. In the former group he places the plateau of Bohemia, the Central Plateau of France, the Vosges, the Ardennes, and the highland of Central Germany; in the latter the Pyrenees, the Alps, the Jura, the Apennines, the Carpathians, and the Balkans. Thus the larger part of France may be considered as belonging in the first group, which includes the region of Aquitania and the Anglo-Parisian area. This latter area is seen in France in the so-called Paris Basin, a term which the author does not approve, because it does not give proper emphasis to the extent of the geographical conditions existing during the period when the rocks now seen about Paris were deposited.

The physical divisions of France in which there has been a unity of genetic development are the North and Northwest, north of Paris and the lower Seine; the Northeast, from Paris to the Rhine and including the upper Saône; the East and Southeast, including the Alps and the Rhone; the South and Southwest, including the Pyrenees and Aquitania; the West, that is, Brittany; the Central Plateau and the coastal area.

In the detailed treatment of each division the author considers first the geological and geographical history in a broad way, and then takes up the detailed treatment of the several subdivisions. In all his work we find evidence of a deep and personal knowledge not only of the surface features of France but of the geological history and the contributions of others to the interpretation of this classic region. The effects of structure upon form and drainage have been worked out carefully, and the relations between diverse regions have been emphasized through a presentation of the earlier geographic conditions attested by a study of the origin of sediments and of the existence of peneplains revealed by the removal of covers laid down in the earlier epochs. Although the author

follows carefully the evidences of various cycles of erosion in the different regions, he does not limit himself to the larger generalizations, but includes a detailed consideration of the history of ancient areas of erosion and deposition, so that the conditions of the present are viewed in the light of the detailed history of the past. The evidences of buried peneplains, the effects of faulting, folding and thrust-faulting upon the ancient land forms, are constantly brought out, and it is clearly shown how much the tectonic history contributes to the understanding of the present surface forms.

The reader of the volume cannot but be impressed with the large contributions to the science which have been made by American geographers. The effects of faulting and folding upon ancient land forms, which have been emphasized by Hayes and Campbell in their study of the Southern Appalachians, by Davis in his classic papers of the Triassic Area of the Connecticut Valley, and by Hobbs in his papers on Southwestern New England, are here emphasized with even a greater detail.

The volume is one of the most helpful contributions to regional morphology at present available, and should receive a warm welcome in America. The descriptions given are clear, concise, and convincing, and the work as a whole is most satisfactory, both scientifically and from the standpoint of good book-making.

R. E D.

Report on the Collections of Natural History Made in the Antarctic Regions during the Voyage of the "Southern Cross." London, Published by order of the Trustees of the British Museum, 1902. pp. 344, 53 plates and numerous text-figures.

This volume is among the first fruits of systematic expeditions into the Antarctic regions. It comprises a series of reports by no less than twenty-four specialists on the animals, plants, and minerals collected during the voyage of the *Southern Cross*. As we are told in the preface by Prof. E. Ray Lankester, Director of the British Museum, the *Southern Cross* was fitted out by Sir George Newnes in 1898 to sail for Victoria Land. It was shut up in the ice-pack for forty days, during which time the young naturalist of the expedition, Mr. Nicolai Hansen, made large collections of birds and seals. In October, 1899, Mr. Hansen died. His notes were lost, and his collections suffered considerably from neglect on the part of the surviving crew. Under the circumstances, it is rather surprising that the various specialists have been so successful in working up the material.

The mammals collected comprise four species of seals (Weddell's Seal, the White Seal, Ross's Seal and the Seal-leopard). There are twenty-four species of birds, including three penguins, eleven petrels, five albatrosses, four terns and gulls, and a cormorant. None of the birds and mammals are new to science. As would be expected, the collections of fishes and invertebrates present a number of hitherto unknown forms. There are eight new species of fishes and three new genera, four new Tunicates, fifteen new mollusks, two insects, one mite, fourteen Crustaceans, three Polychaeta, one Polyzoon, one Alcyonarian, and two sea-anemones, making a total of forty-three new species. Both these and the collections of the known forms show that the Antarctic fauna is singularly poor in species. Nor are any of the forms of a striking or remarkable character, with the possible exception of the penguins, a few of the crustaceans, like *Paratanais antarctica*, and the two sea-anemones (*Urticina sulcata* and *U. carlgreni*), which have brood-pouches for their eggs. These pouches are formed by invaginations of the outside body-wall, and are known to occur only in sea-anemones from the Antarctic and Arctic regions. A similar condition is known to occur in Arctic and Antarctic Echinoderms. It has been suggested that the surface ice in the polar regions may be fatal to the free-swimming larvæ of sea-anemones and Echinoderms, so that the creatures have provided brood-pouches in which their young can develop directly, *i.e*, without a free larval stage.

The volume is provided with a series of fifty-three photolithographic plates illustrating the new and some of the already known species. The figures of the seals and penguins are especially interesting. The paper and press-work are excellent, but the binding is too weak. W. M. W.

A Monograph of the Tsetse-flies (*Genus Glossina, Westwood*) *based on the Collection in the British Museum. By Ernest Edward Austen, with a Chapter on the Mouth-parts by H. J. Hansen, Ph.D. London, 1903.*

The recent discovery that certain flies are carriers of disease has given a great impetus to monographic work on groups of two-winged insects that have long been neglected by systematic entomologists. The interest in malaria has called forth a superb monograph on the mosquitos of the world, published under the auspices of the British Museum. The same institution has now given us a companion volume on the Tsetse-flies, which have been

shown by Surgeon-Major David Bruce to be the carriers of the Nagana disease of cattle, horses, mules, and donkeys in certain parts of Africa. Mr. Austen, the dipterologist of the British Museum, has brought together in this volume of 319 pages, illustrated by several clear text-figures and a series of nine excellent plates, literally all that is known about these interesting insects. The Tsetse-flies are allied to our common stable-fly, a gray, biting species often confounded with the common house-fly. Seven species of the Tsetse (Glossina) are carefully described. One of these (*G. pallidipes*) is new to science. As shown by a good map of their distribution, the insects are most prevalent along the water-courses of Africa. In these regions they occur in peculiar "fly-belts," the crossing of which is often attended by no little danger to the pack-animals. The reproduction of the Tsetse presents a curious phenomenon, hitherto known to occur only in certain flies (*Hippoboscidæ*), parasitic on birds and mammals. The Tsetse does not lay eggs like the vast majority of flies, but a single brown puparium. In other words, a single egg hatches within the reproductive organs of the parent fly, and there passes through its entire larval and incipient pupal stages, being in all probability nourished by certain glandular secretions. Thus the insect produces very few young, but these are not subjected to all the vicissitudes which decimate the much larger broods of ordinary flies. Mr. Austen has accumulated a vast amount of data on the habits and distribution of the Tsetse, as shown by his extracts from one hundred and seventy-four works by travellers and observers who treat more or less incidentally of the insect. He also appends a bibliography of thirty-four works that have already been written on the Nagana disease. This disease is produced by a blood-parasite (*Trypanosoma brucei*), belonging to the same group of microscopic organisms as the malarial *plasmodium*. *Glossina morsitans* is the species most concerned in the transmission of the Trypanosoma. The disease is most prevalent in "German East Africa, British East Africa, and Somaliland, on the east, and in the German protectorate of Togo on the west." It is probable, however, that the other species of Tsetse may carry the disease in the regions over which they occur. It has not yet been demonstrated that Nagana may not be carried by other blood-sucking flies besides Glossina (*e. g.*, *Tabanidæ*). Nor has it been possible to show that Nagana is identical with the disease known as Surra in India. The appendices to Mr. Austen's work contain, among much interesting matter, an excellent abstract of Surgeon-Major Bruce's report of the experiments by means of which he was able to demonstrate the

true nature of the Tsetse-fly disease. A chapter on the anatomy of the mouth-parts of the insect, together with two plates, by Dr. H. J. Hansen, of Copenhagen, is included in the work.

W. M. W.

*Geology of Worcester, Mass.** This volume deals almost exclusively with the hard rock geology of Worcester and immediate vicinity, being based upon work done by Emerson and Perry for the U. S. Geological Survey. The selection of the material and its presentation are the work of Mr. Perry, and he has performed his task exceedingly well. Since the volume is intended, not for geologists, but for the people of Worcester, it is written in as untechnical language as possible. There are many excellent half tones of rock outcrops and hand specimens.

This publication speaks well for the energy of Mr. Perry and the broadmindness of the Worcester Natural History Society. Most such societies are content with mere existence, or, at best, with occasional meetings and the formation of a museum. The Worcester Society is setting before others an excellent example of what they may well do—namely, illustrate and explain to the people the natural history of their surroundings. This, of course, requires also the willingness of a member to do the work; and the Worcester Society is fortunate in having such a member as Mr. Perry.

R. S. T.

International Bibliography of Meteorology.—Volume F of the *International Catalogue of Scientific Literature* contains the titles in Meteorology (including Terrestrial Magnetism) for the year 1901. There are fifty-three pages in the authors' catalogue, and sixty-eight in the subject catalogue. "Climatology and Weather" occupy about twenty pages. The classification of climatology is into four heads—General, Agricultural, Phenological, and Hygienic. Under each of these subdivisions there is a classification by countries. The Bibliography is certain to be of great service to all working meteorologists and climatologists, albeit the first volume is singularly incomplete in giving no reference to the *Meteorologische Zeitschrift*, the leading meteorological journal of the world, nor to the *Sitzungsberichte* and *Denkschriften* of the Vienna Academy of Science, both of which publications frequently contain valuable monographs on meteorological and climatological subjects. R. De C. W.

* The Geology of Worcester, Massachusetts, by Joseph H. Perry and Benjamin K. Emerson. Published by the Worcester Natural History Society, Worcester, Mass., 1903.

Grundzüge des Handels und Verkehrsgeographie. Von Dr. Emil Deckert. Dritte Auflage, pp. 389. Index. Carl Ernst Poeschel. Leipzig, 1903. (Price, 4.20 marks.)

Dr. Deckert's Commercial Geography has established its position as an authoritative book. The first 56 pages are given to the principles underlying the production and handling of commodities. The European countries occupy 186 pages, and other countries are very concisely treated. The United States is covered in 18 pages. The book is a compendium of important facts relating to products, trade, and transportation. Teachers of commercial geography who read German will find the work helpful.

Brasilien und seine Bedeutung für Deutschlands Handel und Industrie. Von Dr. Walther Kundt. pp. 119. Franz Siemenroth, Berlin, 1903.

The central idea of this book is that the German people will derive the greatest advantage in the long run by establishing trade with those newer regions, like the German colonies in Brazil, where German capital and labour may be largely interested in the work of development. In addition, the book is a clear and methodical monograph upon the economic status of Brazil.

Wie rüste ich mich fur die Tropenkolonien aus? Von Ernst Tappenbeck. pp. 56. Wilhelm Süsseroth, Berlin, 1903. (Price, 1 mark.)

Mr. Tappenbeck writes of the equipment required for convenience, comfort, and health during a sojourn in the tropics. He treats the food question with especial fulness; and also offers many suggestions which, though they may relate to small matters, have an important relation to comfort and success, and had better be learned from a book like this than from unpleasant experience. He does not discuss questions of trade or the fitting out of expeditions, as what is adapted for one region may not be for others.

Venezuela und die Deutschen Interessen. Von Dr. Wilhelm Sievers. pp. 107. Angewandte Geographie. Bd. 1, No. 3. Halle a S., 1903. (Price, 2 marks.)

The new periodical devoted to applied geography, or, in other words, to geography in its relation to the progress of human development, has thus far presented papers by Dr. Thomas Lenschau on Ocean Cables, and by Dr. Paul Rohrbach on the Economic Importance of Western Asia. The third number contains Dr.

Sievers' paper on Venezuela. It is gratifying to see that he has distinctly separated his political allusions from his geographical treatment of the subject, for which he is more especially qualified. He gives a third of the book to the geography of Venezuela, a quarter to its products, industry and trade, and the remainder to the people and government. No one is better prepared than Dr. Sievers, who has studied Venezuela on the ground, to give an accurate portrayal of the country in these aspects. It is much to be desired that similar convenient and accurate sources of information for other parts of Latin America be made accessible.

Jahrbuch der Naturwissenschaften, 1902–1903. Eighteenth Year. Edited by Dr. Max Wildermann. pp. xii + 508. Forty-six woodcuts and two small maps. B. Herder, St. Louis, Mo., and Freiburg-im-Breisgau, 1903. (Price, $2 net.)

Dr. Wildermann had the assistance of twelve or fifteen specialists of Germany in the preparation of this record of the progress made in a year in the leading sciences and technical pursuits. Dr. Franz Heiderich, of Vienna, tells in 32 pages what was accomplished by explorers and surveyors in all parts of the world. His summary is excellent and thorough, but it is necessarily very concise. Its helpfulness would be increased if reference were given in every case to works in which fuller information is attainable. Anthropology, ethnology, and meteorology are other subjects treated, of especial interest to geographical students.

Die Vereinigten Staaten von Nordamerika. Von Dr. Otto Hötzsch. 180 pp., 111 illustrations, and a map in colors. Velhagen & Klasing, Bielefeld und Leipzig, 1904. (Price, 4 marks.)

This is a finely-illustrated monograph on the history of the United States. Although the matter is necessarily compressed, the writer has succeeded in conveying sound information, and has closely linked our past with our present, so that the German reader may get a clear idea of the nation as it is and of the influences that have developed it. The book is well indexed.

Köln am Rhein. Von George Hölscher. Hoursch & Bechstedt, Koln a/ Rh., 1902.

A small but quite complete guide-book to Cologne, with many illustrations, plans of principal theatres, an excellent coloured map of the city, and a sketch map of the environs, illustrating half-day and whole-day excursions. The book is fully indexed.

Précis of information concerning the Uganda Protectorate. Compiled in the British War Office by Brevet-Major E. M. Woodward. London, 1902.

This book of 158 pages is a condensed account of the geography, resources, population, industries, and communications of the Uganda Protectorate. Appendix I is devoted to a description of the roads by which the various parts of the Protectorate are reached. In Uganda province the natives are keenly alive to the value of good roads, and co-operate with the British authorities in the gradual extension of the road system. Fairly good roads extend from Mengo, the native capital, to Unyoro province, which borders Albert Nyanza, and to other distant regions, as Toru, Buddu, and Ankole. These roads are from 25 to 30 feet broad, and are remarkably straight. The local chiefs are responsible for their maintenance, and the track is kept in fairly good condition in the well-populated districts. Nearly all the narrower streams have been bridged, but the bridges are not strong enough for wheel traffic. Communications off the main road are maintained by narrow and tortuous footpaths; and on the streams by native canoes. Victoria Nyanza is navigated everywhere, but sunken rocks in the channels between the islands and the mainland require great care in navigation. Entebbe, the administrative headquarters of the Protectorate on the northwest shore of the lake, is reached by steamer in two days from Port Florence, the lake terminus of the railroad.

The value of the book is increased by maps, one showing the routes through the country, another the provinces and districts into which the Protectorate is divided; while a map of the Protectorate in four sheets, on a scale of 10 miles to an inch, shows topography, drainage, and place-names.

Batu na Abubuan Hausa. With translation, vocabulary and notes. By W. H. Brooks and Lewis H. Nott. 56 pages. Henry Frowde, London, 1903.

This little book presents a number of very short pieces written in the Hausa language by an intelligent native, descriptive of Hausa warfare, fisheries, hunting, agriculture, and building. An English translation and vocabulary follow. As the introduction gives the Hausa alphabet, the pronunciation, and the system of transliteration, the book both adds a little to the small stock of Hausa prose, and will also help the student in his general study of the language.

A Search for the Masked Tawareks. By W. J. Harding King. 334 pp., 41 Illustrations, Map and Index. Smith, Elder & Co., London, 1903. (Price, 12 sh.)

Mr. King contributes a new spelling of the word commonly written Tuareg in English, because he thinks the form Tawarek most nearly represents the correct pronunciation; but he saw very few Tuaregs, and is he certain that the spelling he uses represents the prevailing pronunciation? It is confusing to multiply spellings of a name; and a form practically settled in general usage should not be disturbed without the best of reasons.

The book does not disclose the time of Mr. King's journey into the Sahara, but it was evidently some time before the recent military expeditions of Lieut. Cottenest and Capt. Laperrine to the Hoggar mountains proved, apparently, that the Tuaregs are really very weak in numbers and in fighting power, though hitherto supposed to be formidable. Mr. King shows that they are widely scattered over the Sahara; but all the evidence collected in the past two years is to the effect that they can offer no serious opposition to foreign occupancy since the French have learned the art of rapid desert travelling.

Mr. King's journey extended only from Biskra to Wargla, and then northeast to El Wad, where he finally caught his Tuaregs. He learned little that has not been told by Duveyrier and later writers. He was able, however, to secure some photographs of men and women. Other fine pictures illustrate desert travel, and life in the Saharan towns and oases. The vivacious narrative gives the book a fascinating quality, and conveys an excellent idea of the oases regions to the south of Biskra.

A Handbook of Modern Japan. By Ernest W. Clement. Maps and Illustrations. 395 pp. Index. A. C. McClurg & Co., Chicago, 1903. (Price, $1.50.)

This work, as its title indicates, is not a book of travel or of geographical description. Its topics relate to the Japan of the present in its material, intellectual, political, and other aspects. It is not encyclopædic, but gives a clear idea of the things that are most important in the life of the individual and the nation. The reader will be helped by it to understand the moving impulses in all phases of Japan's activities. The specialist will not discover in the book all the material he needs, but at the end of each chapter are full references to the best sources of more complete

knowledge, and these bibliographies are very important features of the volume. The map is commonplace, and shows topography only in a crude manner.

The writer says that the study of the English language may begin in the higher elementary school of Japan, and is required in every middle school which corresponds to our high school. We may look upon the attention given to the English language in Japanese schools as one of the means by which our relations of friendship and business with that empire will be facilitated.

Le Japon d'aujourd'hui. Par G. Weulersse. 364 pp. Armand Colin, Paris, 1904.

The book will prove welcome as an aid to the study of modern Japan. Its chief topics are the geography of the country, the leading cities (Tokio, Kioto, and Osaka), agriculture, the manufacturing industries, education, and the position of Japanese women.

The farmers of Japan appear to be progressive. M. Weulersse says that, in addition to the variety of native fertilizers, phosphates and other chemical agencies for enriching the soil are coming into use. Twenty-seven per cent. of the area under rice now yields two crops a year. From 1892 to 1896 the extent of the tea plantations diminished, but the improved methods of tillage increased the production 17 per cent.

The Engineer in South Africa. By Stafford Ransome, C.E. 320 pp. Maps and Illustrations. E. P. Dutton & Co., New York, 1903. (Price, $2.50 net.)

Though this book was written by an engineer, it is not technical, but is adapted to edify and interest all intelligent persons who, for any reason, would like to possess accurate and solid information about South Africa. The chapters on industrial geography, international colonial relations, the harbours of South Africa, interior communications, diamond and gold mining, irrigation and labour problems, are especially valuable in their geographic and economic relations. So full a description of the harbours, with their lamentable limitations and the methods of development and improvement required, does not appear in any of the larger books on South Africa. A full description of Saldanha Bay is given, with a map and pictures. This almost ideal natural harbour on the

Atlantic coast, sixty miles north of Cape Town, is now to be developed. A large part of it is entirely landlocked, it is large enough to contain at one time ten times as many ships as now visit the ports of South Africa, and has "so much depth of water and natural wharfage that, without excavation or dredging, ships drawing 15 and 18 feet can be moored alongside its coast-line." The chapters on the cost of living and the rewards of labour show that, though high wages are paid, expenses are in full proportion, and the artisan as yet can save no more than he is able to do in England. This is the best work on South Africa that has appeared in some years.

Reise auf S. M. S. Möwe. Streifzüge in Südseekolonien und Ostasien. Von Johannes Wilda. 19 page pictures and a sketch map of the route. Second edition. 301 pp. Allgemeiner Verein für deutsche Litteratur. Berlin, 1903.

Sketches of travel written with vivacity and presenting many different phases of life and scene from the savagery of the Solomon Islands to the modern development of Hong Kong and Manila.

Guide Through Netherlands India. Translated from the Dutch by B. J. Berrington. 201 pp. Thomas Cook & Son, London, 1903. (Price, 1 sh.)

The Royal Packet Company of the Netherlands had this volume compiled for the convenience of visitors to the Dutch East Indies. As the vessels of the company visit all the important islands of the Colonies, the water routes are extensive, the inland routes for tourists being chiefly confined to Java and some coastal districts in other islands. The book describes the numerous points of interest, sketches the various peoples and their ways of living, quotes passage rates, etc. Besides many half-tone pictures there are coloured maps of Java, Dutch Borneo, and the Dutch East Indies, with large-scale plans of Batavia and other leading towns.

The Island of Formosa, Past and Present. By James W. Davidson, Consul of the United States for Formosa, pp. 646, besides Appendix and Index. Macmillan & Co., London and New York, 1903.

Mr. Davidson's book has occupied much of his time for eight years, during which he received a large amount of material from Japanese officials, surveyors, and other sources, besides engaging himself in extended studies in the island.

More than half of the volume is given to the history of Formosa from the earliest historic period, through the Dutch occupancy, terminating in 1661; the twenty-one years' reign of the able Chinese, Koxinga, who made a kingdom of Formosa; the long rule of the Chinese Government, which finally made Formosa a province of China; and the occupation of the island by Japan as the result of her war with China in 1894.

Mr. Davidson gives merely a summary of the geography and geology, but he treats the resources and industries with particular fulness; and a large number of the vital facts, which he gives in very interesting detail, are first presented to the general public in this book, and were collected either by himself or the Japanese.

A long chapter is given to the tea industry, which occupies a large area in the northern part of the island. The best quality of Oolong brings the highest price of any tea in the general trade. The camphor industry occupies a broad belt north and south through the centre of the northern two-thirds of the island in the western part of the mountainous region inhabited by the savages of Formosa. Nearly the whole supply of camphor comes from Formosa; and Mr. Davidson describes the method of collecting this product, a Government monopoly, and the hostile attitude of the savages towards the camphor collectors. In spite of the vigilance of the police about three persons are killed in the camphor camps every day.

The sugar industry, coal, and economic plants are very fully described; in fact, Mr. Davidson's treatment of the economic conditions in the island is almost as valuable and unique as his long section on the savages who occupy the eastern half of Formosa. These tribes, the aborigines of the island, were originally spread over the whole surface, but were finally driven from the wide western plain to the eastern mountains. The studies of Mr. Ino, who is the first authority on these wild peoples, provided Mr. Davidson with much new material with regard to all phases of life among these groups of savages. They number about 113,000, and occupy 7,500 square miles of territory. The other elements of the population are 2,730,000 Chinese, most of whose families have lived on the island for generations, and about 33,000 Japanese.

The final chapters deal with the commerce and industry of to-day and the progress the island is making under the new régime. The appendix includes comparative vocabularies of the nine savage groups, lists of the land birds and mammalia, climatic data, etc. A copious index gives easy access to the entire treasury of infor-

mation, and an economic map in colours shows the distribution over the island of its various resources, including minerals. This book will long be regarded as one of the fullest authorities on Formosa.

Canadian Year Book for 1903.—This publication, now in its sixth year, is a valuable work of reference on contemporaneous Canada. It contains nearly 400 pages, and is packed with information as to the government, products, trade, banks, and other kinds of business in the Dominion. It includes complete lists of the post offices, heads of departments in the Dominion and Provincial Governments, militia organizations, the customs schedules, and full statistics of the national finances and the foreign trade. Many half-tone pictures of public men are inserted. The book is marred by the distribution of advertisements throughout; but it may be too much to ask for perfection in a work containing so much information and selling for 25 cents. It is published by Alfred Hewett, Toronto.

Pamphlets from the Philadelphia Commercial Museum.—Among the recent publications of the Philadelphia Commercial Museum is a pamphlet, "The World's Commerce and American Industry," showing by a series of 86 charts the progress and present conditions of the world's commerce, of the manufacturing industries of the United States, and of British and American shipbuilding. The charts show more clearly than statistics alone would do what proportion of the world's trade belongs to each of the principal nations and the relative industrial importance of the leading cities of the United States. They are accompanied by letterpress amplifying the information. While chart 54, for example, shows the relative importance of our cities in the production of hosiery and knit goods, the note tells why they are now classed with cotton instead of woollen goods. The pamphlet is a quick and ready source of information on many essential features of commerce and manufacturing industries. Another pamphlet, "Commerce of Latin America," presents in twenty pages the most recent facts by means of charts and tables.

Ireland and Her Story. By Justin McCarthy. Horace Marshall and Son, London, 1903. (*The Story of the Empire Series.*)

Brief as it is, this book of less than 200 pages gives what the reader feels to be a temperate and truthful account of the Irish history from the legendary times to the present day. It is not

cheerful reading; but it humanises while it saddens, and those who are not wholly absorbed in their own concerns will learn, perhaps, from Mr. McCarthy's admirable pages to appreciate something of the magic that lives in the Dark Rosaleen.

NOTES AND NEWS.

The Annual Meeting of the Society will be held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, January 19, 1904, at 8.30 o'clock, P. M.

After the presentation and reading of reports, the election of officers and other business, the Hon. Robert Lansing will address the Society on the Questions Settled by the Award of the Alaskan Boundary Tribunal.

On the 23d of February the Rev. Putnam Cady will describe the Physical and Historical Geography of the Dead Sea Region.

The Cullum Geographical Medal. The Council, at a meeting held on the 10th of December, unanimously awarded the Cullum Geographical Medal to Prof. Dr. Georg von Neumayer for services to the cause of scientific geography as explorer in Australia and as Director of the German Naval Observatory in Hamburg.

In November the Royal Scottish Geographical Society conferred upon Robert E. Peary, C.E., U. S. N., President of the American Geographical Society, Honorary Membership and the Livingstone gold medal for his distinguished services in connection with North Polar Exploration in the years 1898–1902.

The Annual Report of the Smithsonian Institution for 1902 shows that the permanent fund amounts to $912,000. The receipts from all sources in the fiscal year ending June 30, 1902, were $150,-774, and the expenditures were $69,653. Among the notable papers in the appendix are Guam and its People, by W. E. Safford; The Panama Route for a Ship Canal, by Prof. William H. Burr, and Volcanic Eruptions on Martinique and St. Vincent, by Prof. Israel C. Russell.

Prof. Dr. Richard Andree, of Munich, the ethnographer, has been succeeded in the editorship of *Globus*, the geographical and anthropological weekly published at Brunswick, by Hermann Singer, the geographer. Dr. Andree will continue to contribute to the periodical.

Dr. Adolf Marcuse, astronomer at the Royal Observatory and instructor at the University of Berlin, has taken charge of the department of geographical surveying in the *Geographisches Jahrbuch*, edited by Dr. Hermann Wagner. He requests that astronomers, geographers, and explorers send him publications or papers containing results which should be recorded.

Dr. Franz Stuhlmann, the East African explorer, has been appointed Director of the Biological and Agricultural Institute at Amani, in German East Africa.

It has been reported that Dr. and Mrs. Bullock Workman claim to have been the first explorers of the great Chogo Lungma glacier. The *Dresdner Anzeiger* of November 17 quotes from No. 21 of the *Mitteilungen des Deutschen und Österreichischen Alpenvereins* the following statement by Major Max Schlagintweit:

> The glacier region of the Congo Lungma was already explored in the year 1856 by my brother Adolf Schlagintweit, and Volume 1 of the Travels of the Brothers Schlagintweit presents a large view of this glacier. The Americans, Dr. and Mrs. Bullock Workman, were not, therefore, the first to set foot in that region, since their predecessor in its exploration was a German.

Brave men lived before Agamemnon, and we have yet to hear from the English and the Indians.

The Index for the volume of 1903 will be distributed with Bulletin No. 1, 1904.

THE

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BULLETIN

OF THE

American Geographical Society

ISSUED IN FEB'Y, APRIL, JUNE, OCT. AND DEC. OF EACH YEAR

VOL. XXXV. No. 1, FEBRUARY, 1903

CONTENTS

PUBLISHED BY THE SOCIETY

No. 15 WEST 81ST STREET

NEW YORK

Single Numbers, $1.00 $4.00 a Year

Entered November 21, 1902, at New York, N. Y., as second-class matter,
under Act of Congress of July 16, 1894.

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BULLETIN

OF THE

American Geographical Society

ISSUED IN FEB'Y, APRIL, JUNE, OCT. AND DEC. OF EACH YEAR

VOL. XXXV. No. 2, APRIL, 1903

CONTENTS

PUBLISHED BY THE SOCIETY

No. 15 WEST 81ST STREET

NEW YORK

Single Numbers, $1.00 **$4.00 a Year**

Entered November 21, 1902, at New York, N. Y., as second-class matter, under Act of Congress of July 16, 1894.

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BULLETIN

OF THE

American Geographical Society

ISSUED IN FEB'Y, APRIL, JUNE, OCT. AND DEC. OF EACH YEAR

VOL. XXXV. No. 3, JUNE, 1903

CONTENTS

PUBLISHED BY THE SOCIETY

No. 15 WEST 81ST STREET

NEW YORK

Single Numbers, $1.00 **$4.00 a Year**

Entered November 21, 1902, at New York, N. Y., as second-class matter, under Act of Congress of July 16, 1894.

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BULLETIN

OF THE

American Geographical Society

Issued in Feb'y, April, June, Oct. and Dec. of Each Year

Vol. XXXV. No. 4, October, 1903

CONTENTS

PUBLISHED BY THE SOCIETY

No. 15 WEST 81st STREET

NEW YORK

Single Numbers, $1.00 $4.00 a Year

Entered November 21, 1902, at New York, N. Y., as second-class matter, under Act of Congress of July 16, 1894.

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American Geographical Society

ISSUED IN FEB'Y, APRIL, JUNE, OCT. AND DEC. OF EACH YEAR

VOL. XXXV. No. 5, DECEMBER, 1903

CONTENTS

PUBLISHED BY THE SOCIETY
No. 15 WEST 81ST STREET
NEW YORK

Single Numbers, $1.00 **$4.00 a Year**

Entered November 21, 1902, at New York, N. Y., as second-class matter, under Act of Congress of July 16, 1894.

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